

DIAMANT

DIGITAL FILM RESTORATION SOFTWARE

DIAMANT V2

Digital Film Restoration Software

Manuals

As of: 6.11.2006

Sample images thanks to gratefull permission from:
Filmes do Serro (Joaquim Pedro de Andrade: Macunaima, 1969)
Philips Company Archives (Musica Eterna, 1951)
Internationale Hanns Eisler Gesellschaft (WhiteFlood, 1940)
Filmarchiv Austria (diverse samples, 1915-1930)

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1 What is new, in DIAMANT V2

Welcome to DIAMANT V2, a new completely revised and improved version of DIAMANT.

Beside minor innovations, DIAMANT V2 provides you with a set of major optional tools.

1.1 Integrated Retouching

So far DIAMANT users could only work with integrated 3rd party applications for manual & interactive repair operations. In DIAMANT V2, the M.I.R. tool (=Moving Image Retoucher) has been developed to provide a native interactive repair environment.

M.I.R. can be started alternatively to the RestorationManager and uses source and destination sequences for retouching.

The operator can use overlay and blend functions in a convenient environment to replace damaged parts by existing content from similar images. Thus the retouching follows ethical preservation guidelines, as there is no “artificial” content creation.

The patent pending Moncole-tool provides high resolution preview, such that the operator receives immediate feedback on the real look-and-feel of his actions.

The MicroLoop-tool is a convenient function for real-time display to judge the effects of the retouched sequence. When loop-display is stopped, the operator is automatically back at the same (temporal) position where MicroLooping has been initiated.

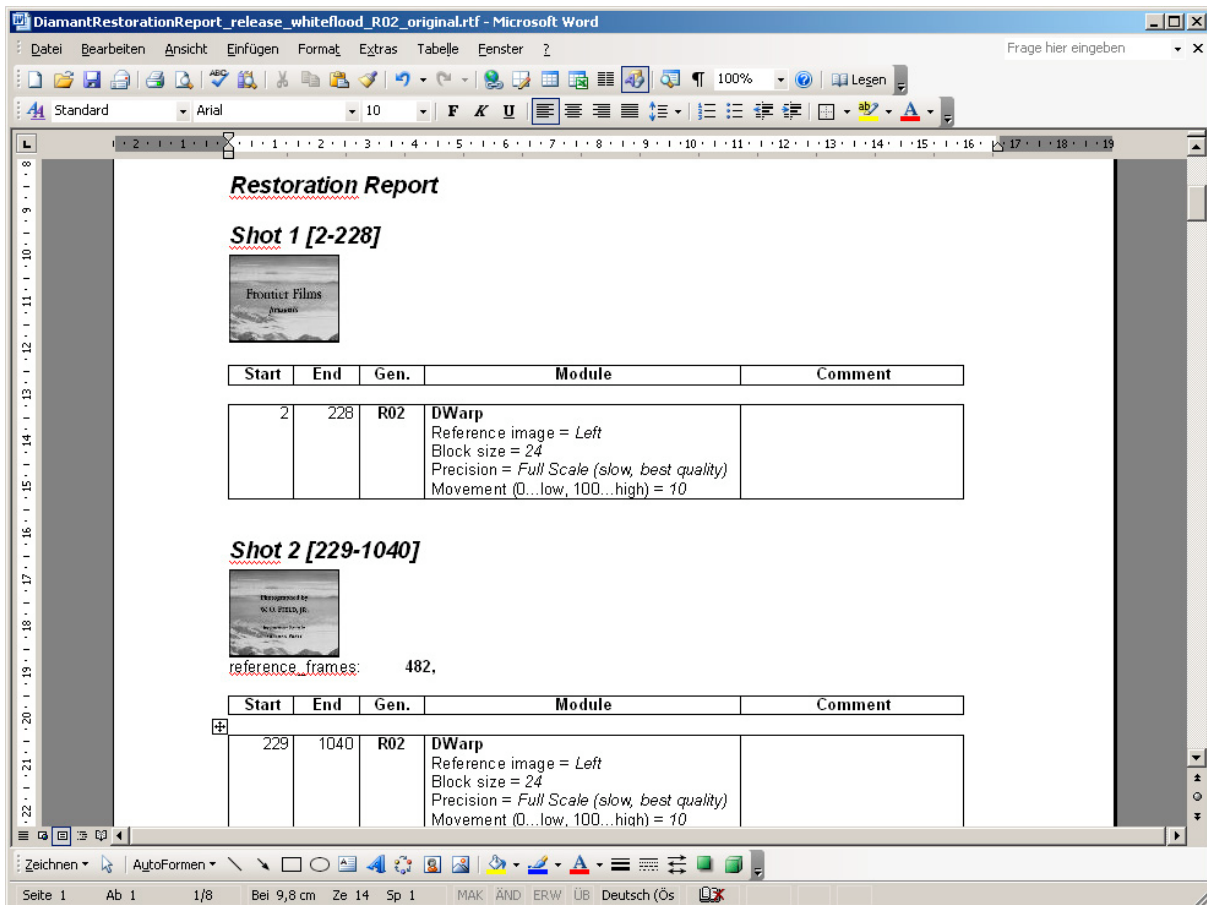
M.I.R. is optimised to a very high degree, thus the operator can get a maximum throughput out of it. M.I.R. is also available as standalone application and is therefore an efficient tool to enhance any DIAMANT-installation by a set of (low-cost) manual retouching workstations.

In case you are used to the old Preview-tool of DIAMANT, we have left it available as an option in the MovieManager. It might be usefull for some specific functions, but in the mid-term it will be completely eliminated.

1.2 RestorationReport

Documentation of the restoration process could be a hard job and consume considerable efforts. Our new RestorationReport, that is simply plugged into the MovieManager, offers an automated way to document the restoration process.

The RestorationReport creates a RTF-document, describing the structure of the film on the level of shots/cuts and all actions/tools applied on the sequences. Due to the nature of the used document format RTF, the operator can adapt the report with Microsoft Word¹ or OpenOffice² according to the individual needs and complete it with any other external information.



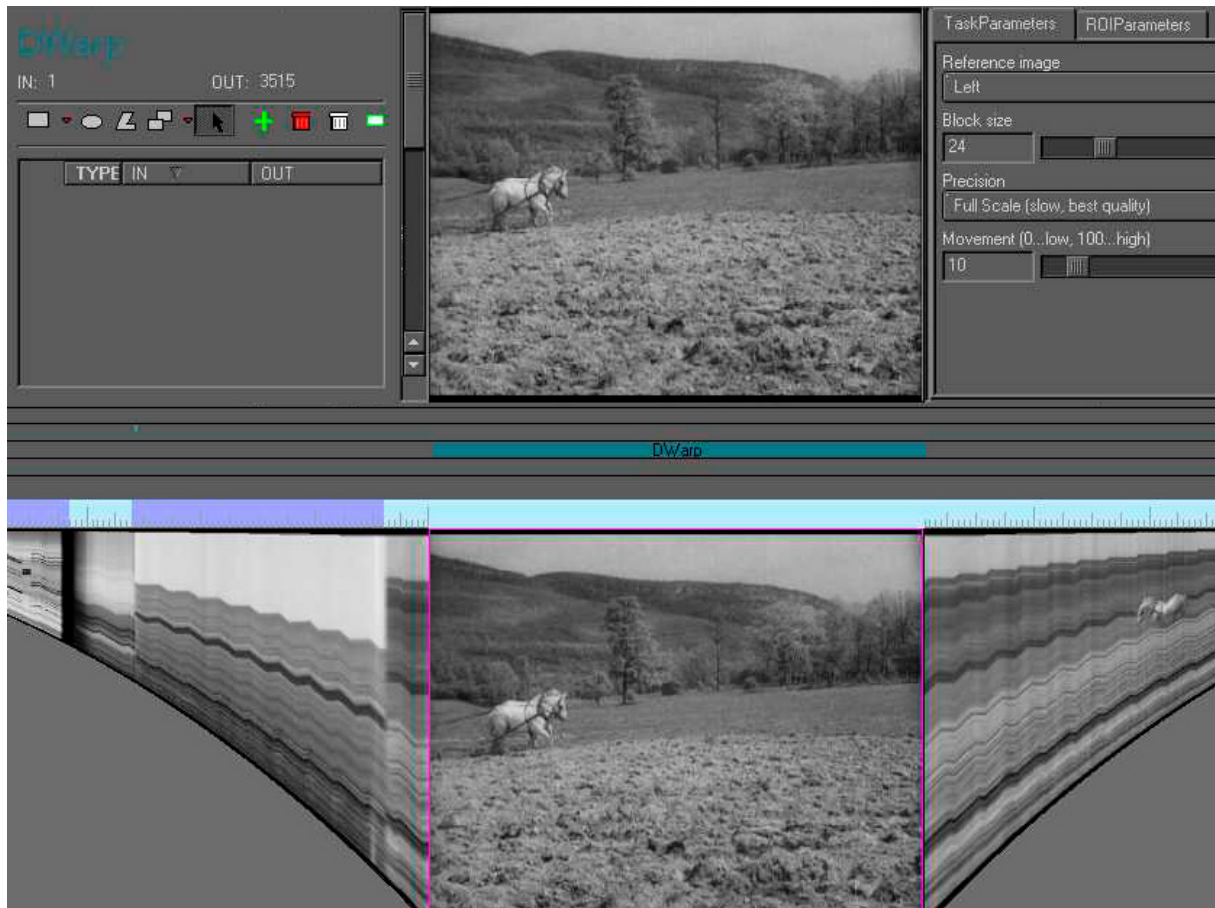
¹ <http://www.microsoft.com/word>

² <http://www.openoffice.org>

1.3 DWarping

Warped and inhomogenous stressed images are very often a consequence of shrunken nitrate, improper splices or non-perfect scanning. Very often such effects become annoying after elimination of other disturbing defects (e.g.: camera movement). So far DIAMANT offered the interpolation tool for a repair of such defects.

DIAMANT V2 brings the new DWarp tool, that uses the image information of the stressed and warped images and does not drop any original content. The correction is based on a reference image, that is used as basis for detection of the DWarp-Function. It is recommended to use a neighbouring image as reference, although you can principally apply the DWarp tool on several consecutive images in time.



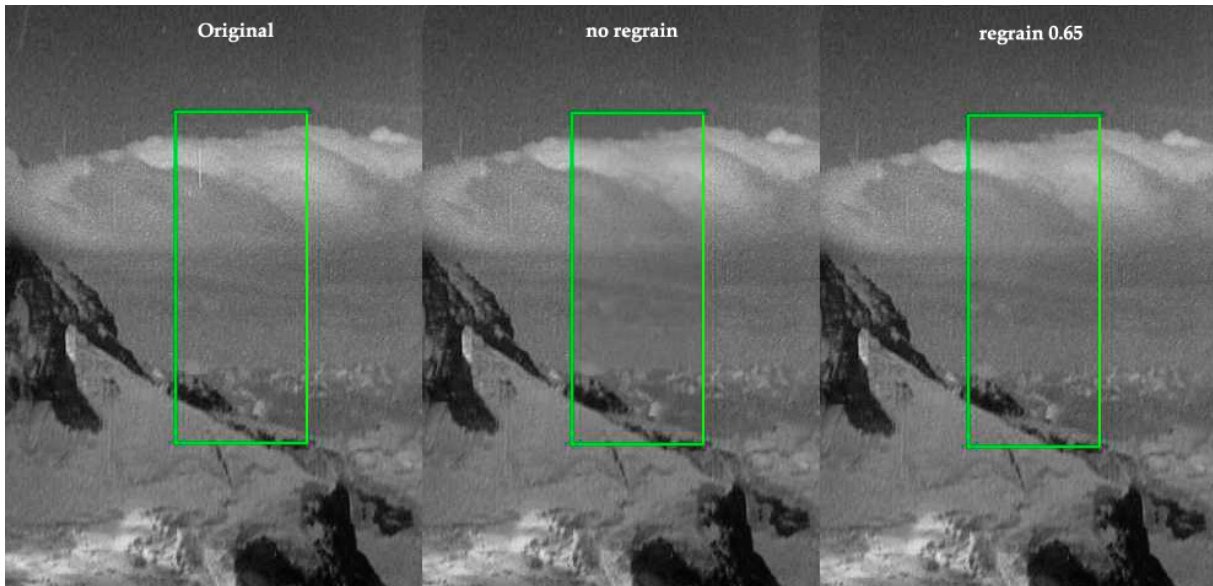
Be carefull with the use of reference images. References can be used for brightness correction (DFlicker) and for DWarp. Thus it is strongly recommended to seperated DFlicker and DWarp tools in restoration generations. Just make always sure to use proper references. Usually a good reference for DFlicker is not the same than a good reference for DWarp.

1.4 RGraining

Restoration of heavily affected films might result in a dramatic loss of original film grain. In order to compensate for this undesirable effect, we have already introduced a first version of our RGrain tool in the previous DIAMANT.

However, the new RGrain is not restricted any more to a few predefined grain-patterns, but it permits to extract the grain automatically from any other parts of the movie or even other sequence and to use this so called “custom template” grain pattern on any other place inside DIAMANT.

Thus it is possible to create a homogenous appearance of the film, eventhough its original parts might originate from various sources and generations.



Beside the RGrain tool, we have also added a `regrain`-option in our well proven interpolate-tools. Before, interpolation of grainy material resulted in a considerable loss of grain on the interpolated parts. Now, using the new `regrain`-option you get a well fitting interpolation, without loss of original structures.

1.5 PixelMotion

Calculation and extraction of moving objects is an essential step in the restoration process. Moving objects are described best by the movement of individual pixels. Beside the well proven LocalMotion tool, the operator has the choice to use the new PixelMotion tool. This tool is an alternative! To LocalMotion, providing similar results at significant higher computing efficiency. PixelMotion provides you with a speed-up of about 100% and should be used as basis for our Dust and DNoise tools.

1.6 Preprocessing

In older DIAMANT versions we have been using a tool called pyramid/quickpyramid for preparation of the restoration process. The new preprocessing tool replaces pyramid/quickpyramid but also stripe and shot. The tool is significantly faster, makes optimised use of the render-farm and provides all necessary preprocessing functionality in one tool.

*Be aware that we have also introduced another terminology. In DIAMANT V2, we call all automated processing, that can be started directly from the MovieManager, **Batchprocessing** whereas the first tool, that needs to be applied after importing a sequence is called **Preprocessing**.*

1.7 Real-Time Playback with QuickTime

DIAMANT V2 supports the QuickTime format in the following way:

- Import and export of (pre-captured) QuickTime movies is possible by means of CaptureManager and the specific quicktime device. For handling a full feature quicktime movie we recommend to use our batch-import tool, that automatically creates virtual sequences of user-defineable duration out of one big QuickTime movie.
- If the ExportQT tool is applied as last module in the RestorationManager the QuickTime always holds the latest restoration results in it.
- By using the ExternalSync mode in the RestorationManager you can then replay the (restored) QuickTime on any supporting hardware-device in real-time.

- We have tested DIAMANT and QuickTime on BlackMagic DeckLink HD Pro boards³ and on DVS products⁴. In case you consider using such a device, we are ready to provide you with further information and consultancy.

1.8 Enhanced timecode / keycode support

Since DIAMANT V2 we support keycode as defined in the DPX file format standard. When importing a sequence with a valid keycode, DIAMANT V2 extracts the code of the first file and keeps it as startTC inside DIAMANT. When exporting the result, the keycode is re-introduced into the files.

1.9 Configurable Keyboard and Mouse (Shortcuts)

DIAMANT V2 provides a new improved and optimised keyboard-handling respecting the major operator-feedback we have collected in the past. However, as this new setting might also lead to some confusion the operator can decide if he wants to stick with the traditional environment, go with the new DIAMANT V2 environment or even configure his own.

1.9.1 DIAMANT V2 keyboard settings

According to some user's feedback we have been changing some of the default keyboard settings. In general most of the settings for RestorationManager and M.I.R. can be individually configured.

The most important changes is:

Current short-cut	Previous short-cut	Description
TAB	Ctrl+d	Toggles between source and target (before/after) in the upper window of RestorationManager resp. in the M.I.R.

M.I.R. offers many new functions for DIAMANT and thus also uses slightly different shortcuts. Please refer to a detailed description of M.I.R.

³ <http://www.blackmagic-design.com>

⁴ <http://www.dvs.de>

2 Installation

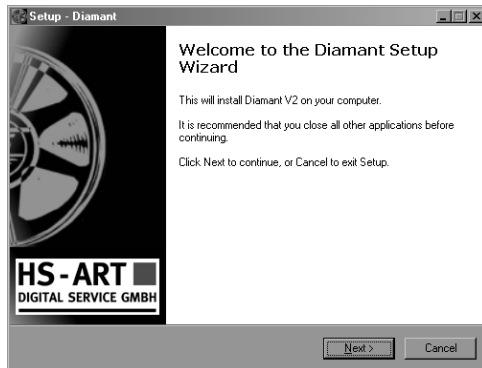
So far the standard installation for DIAMANT has been c:\limelight. The historic name of Limelight has been given up in DIAMANT V2, now the default installation path of the software is C:\DIAMANT.

With your distribution you have got:

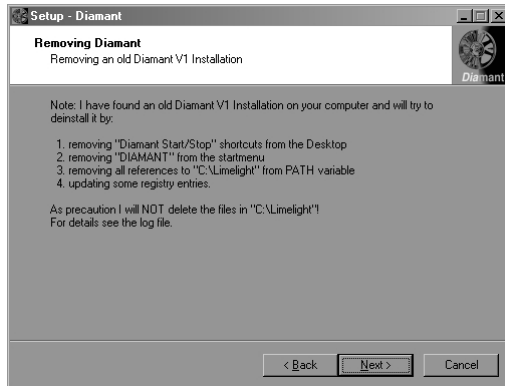
- DIAMANT V2 CD with software, manual and tutorial files
- USB Dongle
- DIAMANT V2 Manual

2.1 Central workstation

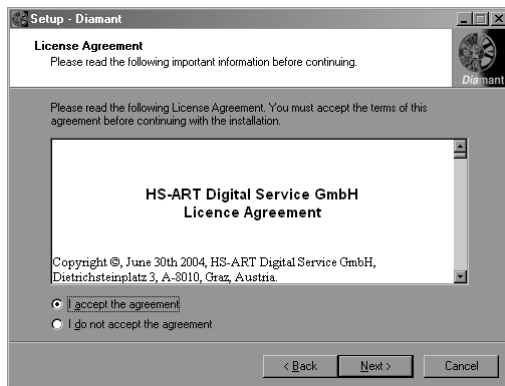
Insert the DIAMANT V2 CD in your drive; log-into your workstation as user with Administrator-rights and start Setup.exe.



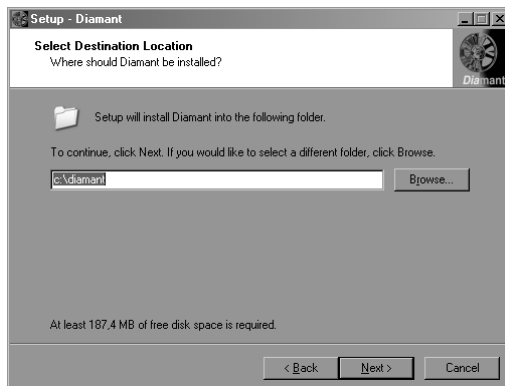
Setup leads you through the installation process, that is pretty much self-explaining.



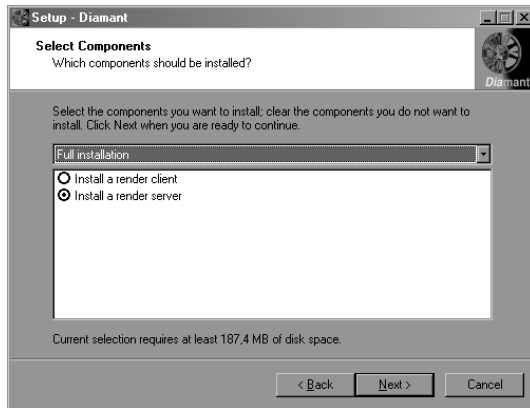
Setup recognises if you had already a DIAMANT installation before on your workstation and proposes such eventual settings as defaults for the installation.



You need to explicitly accept the DIAMANT V2 licence agreement that is valid as long as you have not negotiated any individual agreement. Such individual agreement apparently supersedes the “standard” agreement.

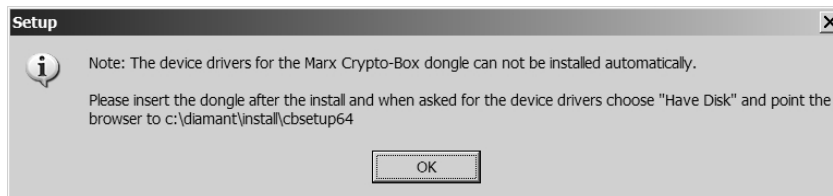


We strongly recommend to keep the proposed installation directory as C:\DIAMANT as this facilitates support.



Decide if you want to install a workstation (i.e.: server or standalone) or a render client. Usually you start with the installation of the central workstation. For render client installation refer to chapter 2.3.

In the course of the installation the driver for your USB dongle needs to be installed. This is done automatically. Just confirm the installation for USB Versa.



In case of having Windows 64bit, you need to install the drivers manually after installation. This is quite simple. Just plug the dongle to a USB port and Windows will ask you for the driver.



After successful installation the components of DIAMANT V2 are available from the startmenu of Windows.

2.2 Configuration

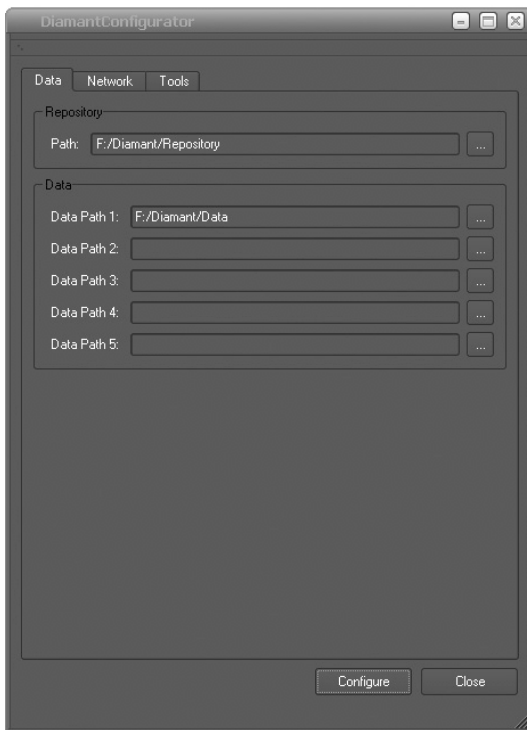
After installation, an initial configuration needs to be done on both, central workstation and render client. The configurator is started directly by the installer and you need to complete the entries before confirming with configure.

The configuration is 3-fold.

Data section

Repository

The repository is the location that holds all valid meta-information about your movies, jobs and data. It should be on a shared drive with read/write permission for all users on the main workstation, but also for all users from render clients.



Make sure that the repository is accessible by the same name (including drive name) for all workstations running Diamant. If this is not the case any self-test in the JobManager of the main workstation will fail.

Data Path 1 –5

In Diamant we currently support up to 5 data paths. A data path is a location that holds the image data and thus the most consuming parts of your movie. Any sequence in DIAMANT needs to be loaded into one specific data path (during import in MovieManager) and all DIAMANT generations of this sequences are hold on the same path.

Usage of several paths makes sense if you work with different disk-arrays, that might be even on different computers for a better balanced network-load. Usually you use more than one data paths only if you have a render-farm, for single workstations just enter a value for data

path 1.

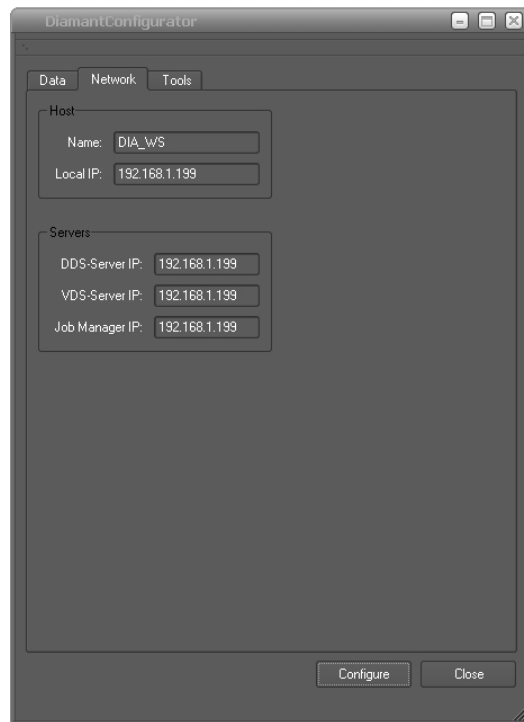
The requirements for data path are the same than for repository. Proper sharing, rights and accessibility needs to be implemented on the administrative level, such that the central workstation as well as all render clients have same access conditions.

Network section

Name

This is the name of the local computer. The name is used in JobManager to describe the workstation or render client. It can be *localhost* in single workstation environments (0no render client).

Local IP



Is the local IP address that is used for communication between central workstation and render clients. It can be *127.0.0.1* in single workstation environments (=no render client).

DDS Server IP / VDS Server IP

Is the IP address of the workstation where the DDS Server is running (usually the central workstation). If you work with external video devices, such as DDR you can also enter a different IP for the video server (VDS), but for starters that should be the same than DDS.

The DDS Server in DIAMANT manages import/export. Usually the DDS Server is a background application on the central workstation. It is a component that is used in the import/export process.

JobManager IP

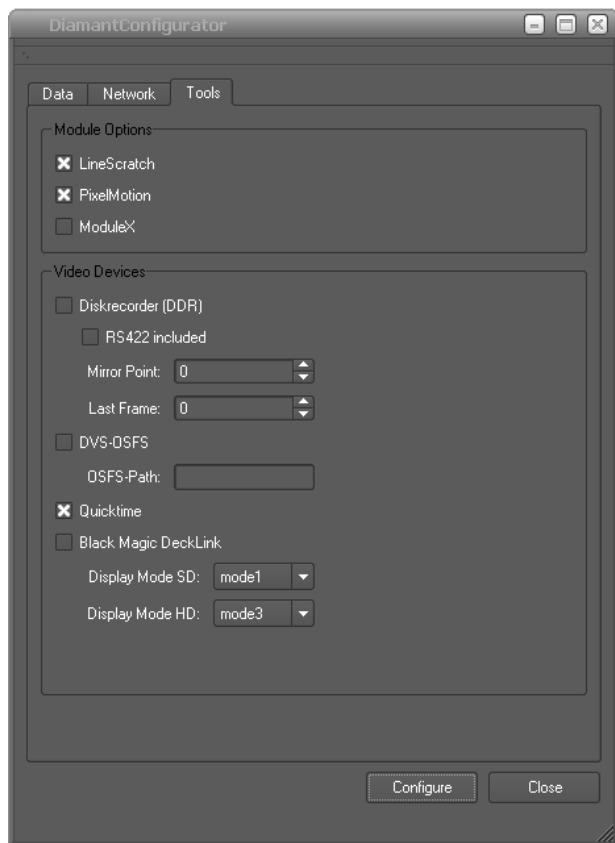
This is the address of the workstation running the

JobManager. Usually it is the same than the DDS Server IP as both components are running on the central workstation.

Tool section

Module options

DIAMANT V2 offers additional (optional) tools. Depending on your license you might have them or not. The optional tools can be activated in this section, but if you do not have the proper license (on the USB dongle) you will get an error message.



Samples for such optional tools, that are beyond a standard DIAMANT V2 distribution are Linescratch and PixelMotion.

Video Devices

Video devices add the capability of real-time preview, capture and play-out to DIAMANT. So far we offer a few options at different level of integration. If you have any specific requirement do not hesitate to let us know....

Check those options that you have available on your central workstation.

- Diskrecorder (DDR)

The diskrecorder usually supports RS422 and if you want to work with a MirrorPoint for comparing before-after restoration you should enter the separating point here. A value of "0" disables the MirrorPoint, so that you can only see the restored sequence

on the DDR. "*LastFrame*" describes the last number, available on the DDR.

- DVS-OSFS

If you work with products from DVS that support OSFS mode, you can enter the drive and path of the disk, that provides OSFS service.

- Quicktime

Check if you want to work with quicktime files.

- BlackMagic DeckLink

If you work with the product line DeckLink from BlackMagic you have to select the video mode for PAL and/or HD resolutions.

See chapter 4.2.19 for more information.

Complete the configuration by confirming with “*Configure*” or aborting with “*Close*”.

2.3 Render client

Once DIAMANT is running properly on the central workstation you might chose to add render-clients (depending on your license).

Render clients add render-power, they do not have any operator interface. Be aware that any render client should run under the same user/password than the central workstation.

The installation procedure is almost the same for the render client than for the central workstation. You just have to select *render-client* in the course of the installation process.

In case of a render client, DIAMANT-Start is entered in the Autostart-menu of Windows. If you enable an automatic login at start-up of your render-client, you will find JobLauncher always running on the client. This feature facilitates your render farm management a lot!

All following updates and fixes can be simplier installed on the render client, by using the “*SW Update*” option from the JobManager on the central workstation. Refer to chapter 3.2.2 for more information.

2.3.1 Tips and Tricks

Users

We strongly recommend to use DIAMANT with a common user from all render-stations and on the central workstation (resp. file server).

Please create a user “diamant” and provide it with Administrator privileges.

Central workstation

Please make sure that the fileserver for the DIAMANT repository and data permits a proper number of network users. Be aware that Windows XP permits only 10 users at the same time, thus we strongly advise to use a maximum of 4 additional render-stations (i.e.: 8 parallel render processes). If you use more, than please increase the number of permitted network users or even better, use Windows 2003 Server.

Please configure a network-share for the diamant data and repository drive with read/write permission for the user “diamant”.

Render-Clients

Please configure AUTO-Logon for user “diamant” and map the data and repository drive on all render-clients. Please use the IP-address of the server to map the drive to the same name than on the central workstation (resp. file server)!

Firewall, Anti-virus protection

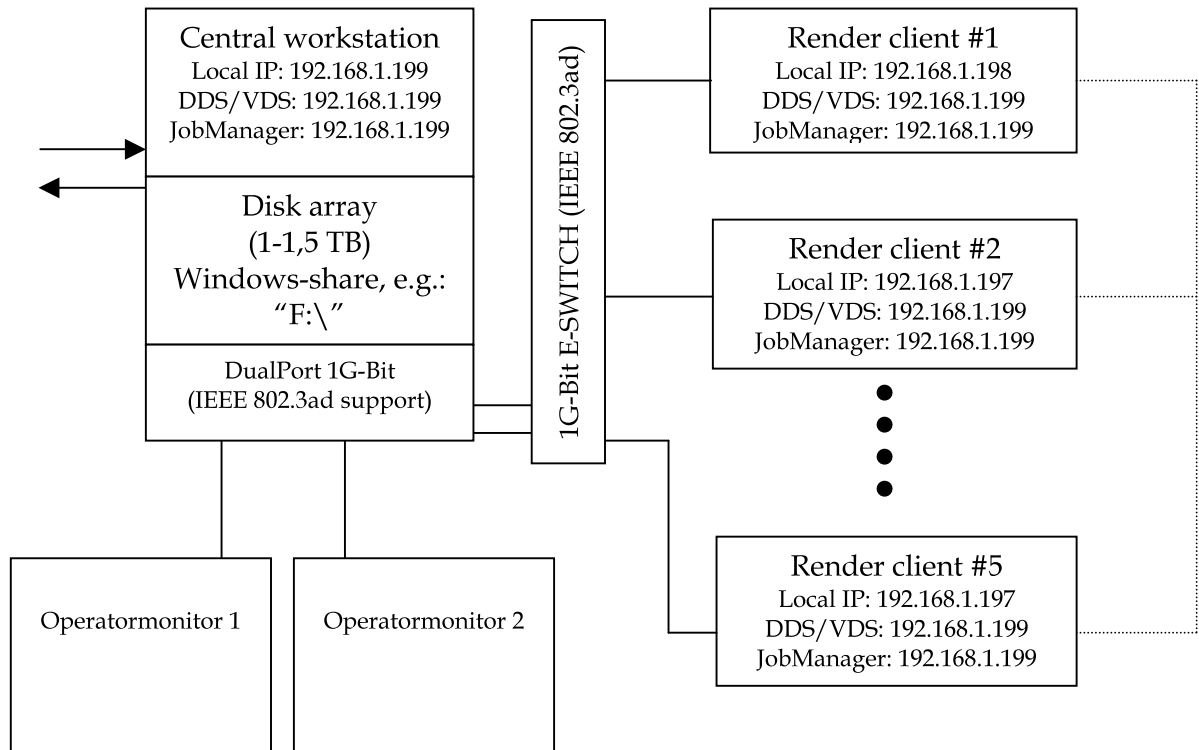
In order to increase performance of Diamant we generally recommend to turn off all Windows firewall and anti virus software. Please ensure by other means that your system can not be illegally accessed resp. misused!

We also recommend to turn-off any other services that are not needed to operate the Diamant system (e.g.: printer spooler, etc.).

2.4 Sample hardware setup

The following draft provides a sample hardware setup for a full featured DIAMANT V2 Suite with central workstation and 5 attached render clients. Such a systems offers a daily throughput of 10-30 minutes of HD/2k films.

The purpose of this sample setup is to provide you with ideas for an optimised configuration. We offer our help for any tailored solution – just contact our team.



3 Operation

Restoration with DIAMANT software is comprehensive and straight forward. Basically you have the following general workflow:

- Content selection and importing
- Automatic and control
- RestorationManager
- M.I.R. - Manual Retouch
- Exporting and finishing

3.1 Content selection and importing

3.1.1 Starting DIAMANT

After the successful installation of DIAMANT you should find the following shortcut-icons on your desktop to start resp. stop your DIAMANT.



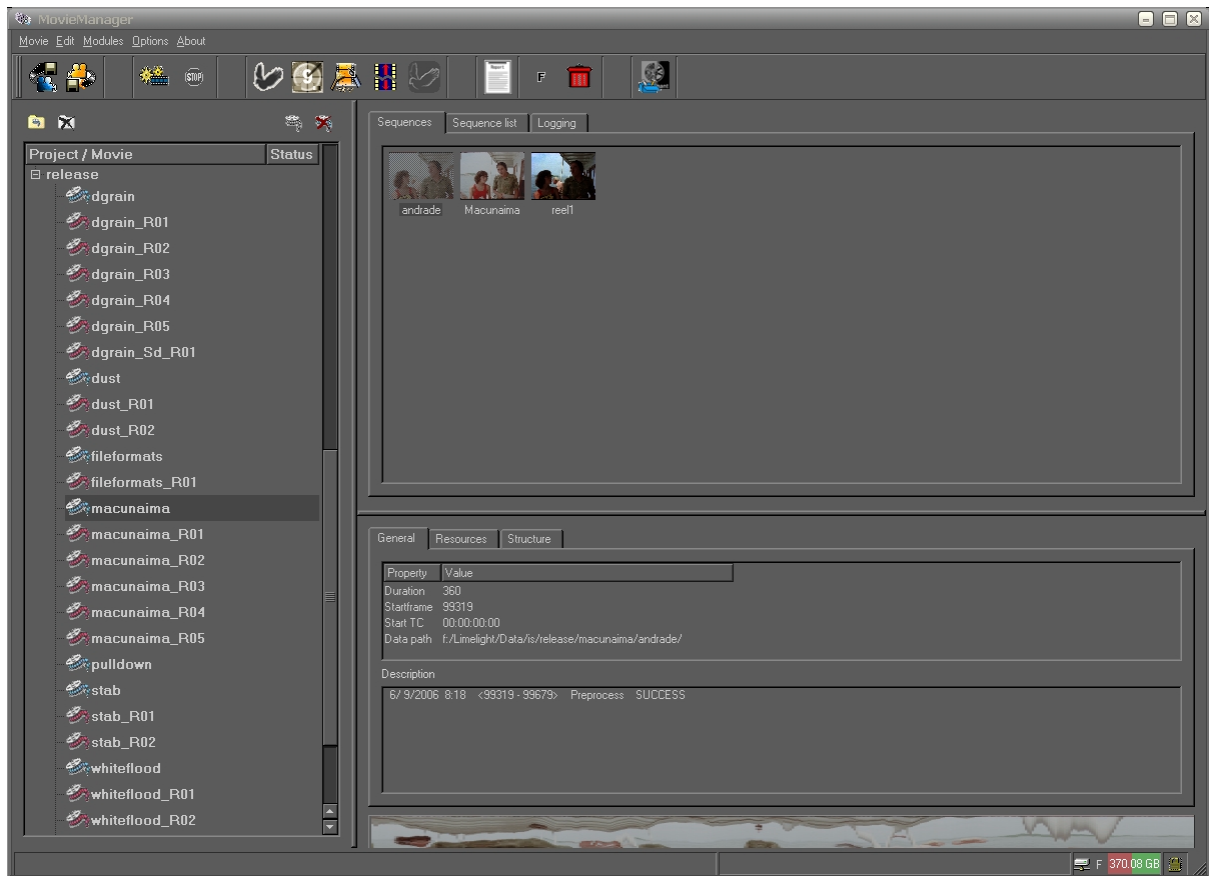
DIAMANT itself consists of several interlinked applications that can also be started individually. To do so, you simply select from the Start Menu “Programs”, the “DIAMANT” folder, containing entries for the individual applications.



ATTENTION:

If you do not find these items as described on your workstation than the DIAMANT installation has most likely not completed successfully.

Refer to the “Installation Procedure” and make sure you are logged on as “Administrator” while running the installation procedure.



3.1.2 MovieManager

This application provides you with the basic environment for all further work.

- Give an overview of all existing projects and their hierarchy in the so called “Repository”.
- Show all sequences of a selected project by name and icon and their status if there is a batch-process running on them.
- Provide information on the selected sequence in terms of “General”, “Resources”, “Structure” and “Description”.
- Show the so called “stripe image” of the selected sequence, that is a temporal view of the whole sequence at once and is available after pre-processing.
- Get an overview of disk-space available and consumed by DIAMANT.

Project selection

Blue coloured movie-reels indicate “original” movies, that come from external sources. Such original material is never changed, so there is always a way back for the operator.

Red coloured movie-reels indicate that they have been created in the restoration process. Any red coloured reel refers back to either a previous generation or to a original one. The naming convention is usually the basic name (as from the original), followed by the generation-counter (eg.: _R01, _R02,...).

Selection of a project updates the *sequences* window and displays all image sequences (=icons) related to the selected movie.

Therein, the following information is available:

- a symbolic view with icons, name and pre-processing summary,
- a formal list-representation,
- logging view, where the status of processing jobs/requests is visualised.

Sequence selection

The icon resp. the sequence is selected by clicking onto it, like on the native Windows desktop. The selection updates the *information* frame where the information relevant to the image sequence is displayed. You can select more image sequences by holding down the CTRL-button and clicking onto the desired icons, then only information is displayed which is common for all selected sequences.

General and Description

This tab shows general information about the image sequence. These are for example, duration, start time code and length.

Any free-text comments relating to a specific image sequence can be stored in the “Description”-section for later usage. Some of the pre-processing applications automatically create descriptive information herein to show the results of their application.

Resources

This section informs about available previews. Right after import of a new sequence there will be only a reference to “Original Data”, however after processing there is “Render Data” and –depending on your configuration- some compressed “Viewing Data” for quick access.

If you double-click on any available resource, the previewer will open for immediate viewing.

Structure

This section provides information about the structure of the selected sequence. Cut information and reference images of the sequence are displayed.

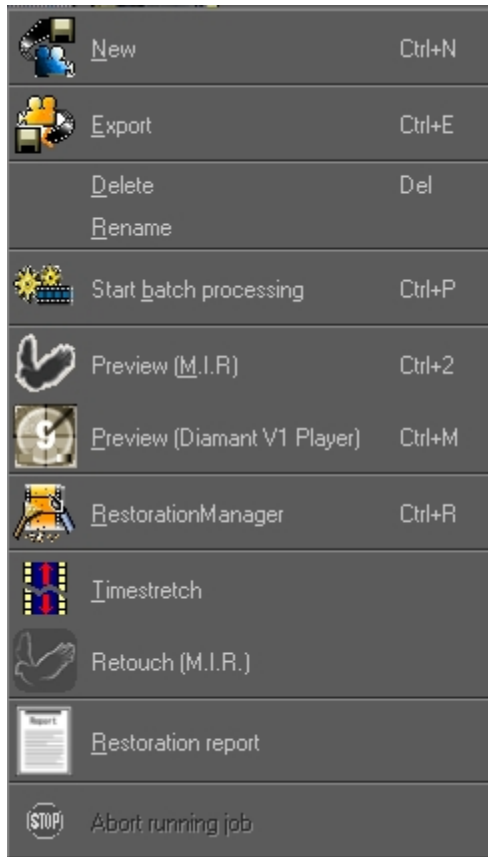
Stripe image

Moreover there is room for a temporal compressed visualisation of the image sequence, which is later on referred to as “stripe image”. This image, if available, shows the full length of the sequence, indicating colour-information as well as camera changes (cuts).



Main operator controls

The operator can interact with the MovieManager either by interaction with the tool-bar or by selection from the context-menu of the sequence.

**New / Export**

Creates resp. exports sequences in MovieManager from/to various devices.

Before a new image sequence is visualised in the *sequences* window of MovieManager it has to be imported.

Usually a new sequence is created in the currently selected movie/project. However, if you decide to import sequences into a new movie or project you just have to define that in CaptureManager, which results in the creation of a new movie entry or project directory in the *repository*

Delete / Rename

Deletion of sequences, movies or even projects is possible at one selection. Be carefull as this destroys all data! Renaming is principally possible, but we do not recommend it, as it might take a while when working with long sequences.

Batch processing

Prepares the sequence for restoration, creates previews and analysis data, but it also offers the interface for automatic restoration.

Preview (M.I.R. resp. Diamant V1 Player)

Provides a preview possibility for your sequences. The Diamant V1 Player is still there if you are used to it, however M.I.R. provides a better suited playback with more functions. Be

aware that previewing with M.I.R. does not permit to do any retouch-actions. For that you need to start M.I.R. in Retouch mode. Refer to chapter 3.4 for more information.

RestorationManager

Main application for semi-automatic restoration, can be started on all sequence that have been prepared by Batch processing (Preprocess).

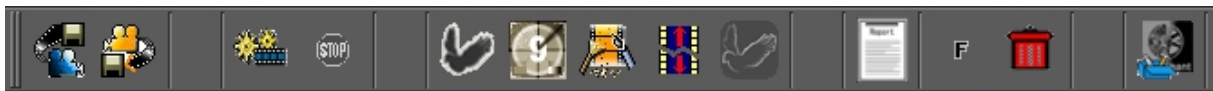
When launching the RestorationManager for the first time a new movie and sequence is created as a place-holder for the restoration results. Typically the new movie is visualised in the *repository* with red colour, whereas the new image sequence is just displayed in the *sequence* window of the newly created movie. All restoration results produced from within RestorationManager are kept in this newly created (*derived*) image sequence, therefore the original is never affected by RestorationManager.

The naming convention on those *derived* movies can be set in the “Configure” section of the MovieManager. Default is a numbered suffix to the original movie name. Default suffix starts with “_R01”. When starting RestorationManager with selected movie “_R01” the newly created movie is simply counted up to “_R02” and so on.

Retouch (M.I.R.)

Main application for preview, quality control, manual repair and finishing. New in DIAMANT V2. Opening M.I.R. in the retouch mode opens the selected sequence as source sequence and the next DIAMANT generation as target sequence. If the next DIAMANT generation does not exist, it is created before.

Other usefull operator controls



Rename and move of sequences

You can move a sequence to a different movie/project by drag&drop. You can also rename the sequence or a movie/project by using the context-menu.

However we recommend to use this only in exceptional cases, as this step affects the file-structure and might consume quite a time for long sequences.

Timecode/Frames

Defines quickly if the operator prefers to work in:

- F.. Frames (usually for film, ie.: single images)
- T.. TimeCode (usually for video)

Waste bin

The waste-basket should be periodically used to clean-up LOG-files and temporal backups used by DIAMANT.

Configure

The set-up is divided into several components and offers you a wide possibility to personalise your working environment.

Please be carefull with changes, when you do it, then avoid making changes during a running project. Some changes could significantly affect your restoration quality.

- Repository

You can change relevant settings for your repository. This includes the typical suffix for indication of DIAMANT sequences (default is "R"), but also the way how you want to handle JPG-previews or multiresolution. In general we recommend you to leave the values unchanges, despite you get some advise from us resp. your reseller to make a change. Be aware that this setting only affects new sequence that are imported after making a change.

- Jobs

You can change the preconfigured number of retries in case of failure on jobs. If you have stability problems with your disks (e.g.: SAN) and/or your longer restoration jobs fail quite often, you can try to increase this value.

- Display

You can change display and screen colors as well as indicate your preference for Timecode or frame numbers.

- RestorationManager

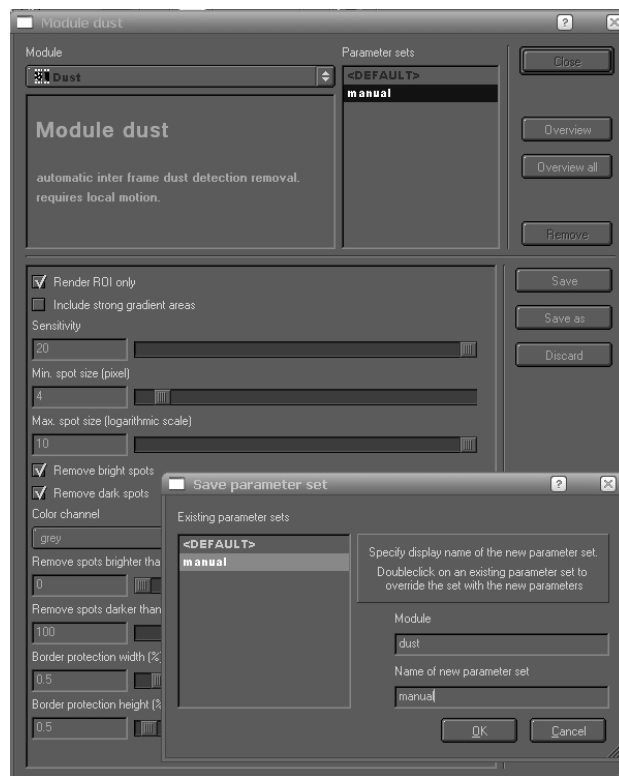
Permits to personalise your RestorationManager, you can turn-off the stripe-image, show the Reference markers, etc..

- Image

Influences the way how DIAMANT interpretes different fileformats. You can set the quality for JPEG as well as the internal LookupTables for DPX and CIN files.

- Modules

DIAMANT can store and administrate specific, personalised module settings for the restoration tools. Here you can create, re-name and delete your personalised tool settings on a tool-level.



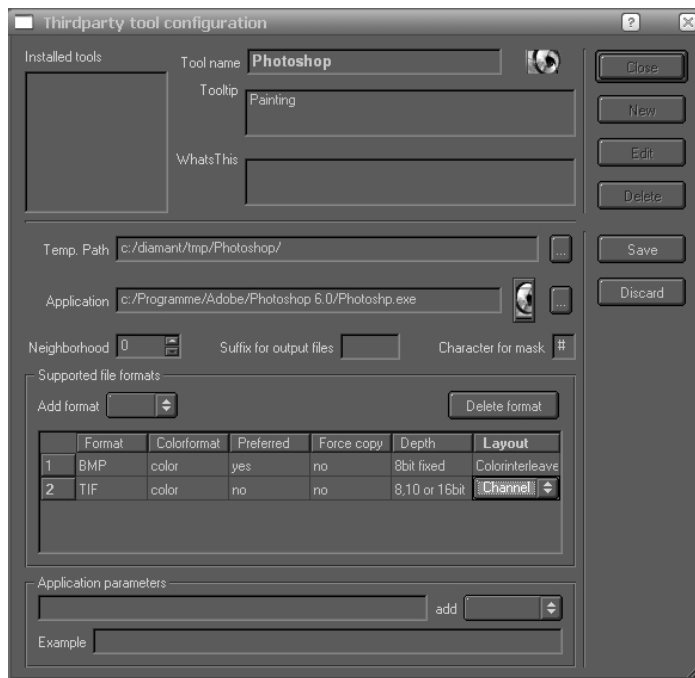
- Thirdparty

DIAMANT allows to integrate third party software applications to extend the image processing capabilities of the system. Typical applications to be integrated are specialised painting programs (e.g., Cinecure by Imagica) or general image processing packages such as Photoshop or Gimp.

To integrate an application, DIAMANT needs to know several parameters such as permitted data types, location of executable, etc.

Configuration of a third party application

The function is available from the Configure menu of MovieManager.



In the top left corner, a list of all configured third party applications is displayed. To edit an existing configuration, select the entry and click the “Edit” button. To add a new application, click the “New” button. After adding or editing an entry, click the “Save” button to save the changes, or click the “Discard” button to exit without saving. To delete an entry, select the entry and click the “Delete” button.

The configuration of each application consists of various settings defining the behaviour and working environment of the applications. These entries are:

- Tool Name

Is the name of the application as you want to see it in DIAMANT.

- Tooltip

The text entered here will be displayed as the tooltip message when the mouse cursor is moved over the application's icon.

- Temp. Path

This is the directory used to exchange image files between DIAMANT and the application. A separate temporary directory should be used for each application. Typically, the folder `c:\diamant\tmp\<ApplicationName>` is used.

- Application

This is the full path to the applications main executable. Type in the correct path, or open a selection window and select the required executable.

- Neighbourhood

This is the number of frames before and after the current frame that will be opened. If set to "0", only the current frame will be opened.

- Suffix for output files

Some applications require the use of different files for input and output. Such an application would for example load a file called "frame1.dpx" and write the result of it's processing to another file called "processed_frame1.dpx". In this case, the Output File Suffix would be set to "processed_".

If an application writes the results back to the same file, this field is left empty.

- Character for mask

While some programs will take the actual filename to load as a parameter, other applications require to specify a "file mask", i.e. a template to create the file name from a frame number. Within such a file mask, one character is used as a wild card for the numbers. This setting specifies which character to use.

- Supported File Formats

Each application supports a certain variety of file formats. In case the format used by the DIAMANT image sequence is supported, the files will be handed over directly to the application. If the file format is not supported, the DIAMANT software will convert the frames to a supported format first and then hand the copies over to the application.

For a working configuration, this window should contain a list of file types supported by the application, together with bit depth and color mode information for this file type. To add a new entry, click the arrow next to the “Add Format” box and select the file type to be added. Next, select color format and bit depth supported for this file type.

Preferred: This option selects if the file format is preferred above the other formats. E.g., if a file has to be converted, it will be converted to the “preferred” format (instead of all other available formats).

ForceCopy: This option forces the DIAMANT system to copy the image files before handover, even if the file format used would be supported directly by the application. This can be necessary to ensure reliable operation with some applications.

Example:

	Format	Colorformat	Preferred	Force copy	Depth	Layout
1	BMP	color	no	no	8bit fixed	Colorinterleaved
2	TIF	color	yes	no	8,10 or 16bit	Channel or color
3	TIFF	grayscale	yes	no	8,10 or 16bit	Channel or color
4	TGA	color	no	no	8bit fixed	Channel or color

In this sample the application accepts BMP, TIF and TGA fileformats. Any other file format in DIAMANT needs to be converted, the preferred format for conversion is TIF (Preferred = yes). BMP, TIF and TGA files can be directly treated in DIAMANT, there is no need to work with a temporary directory (force copy = no).

To change a setting in the list, click on the respective entry field. A selection arrow will appear on the right side of the field. Click the selection arrow and select the value from the drop-down list.

- **Application Parameters**

This entry field specifies the commandline string passed to the application. This string can be composed of various predefined text variables, such as input file name, input path, frame numbers, etc.

First, determine which information has to be passed on to the application. Then, compose the necessary information using the available text variables from the “add” box. The “Example” field will display an example for the composed command line. (NOTE: the path to the executable and the executable file itself will not be displayed in the “Example” field !)

3.1.3 Import

Device

The device from which the sequence should be imported needs to be specified and influences the import dialog.

Project / Movie / Sequence

In order to import a new sequence you have to set a movie and an image sequence name (optionally set a new project).

Duration

The duration indicates the length of the sequence, either in number of frames or as time-code dependent on your preferred setting. Be aware that this value is usually automatically determined from the device dependent settings for Source in/out. However if you decide to set the Duration manually, than Source in/out are adapted to match this setting!

Frame rate

Optionally, the number of play-rate (fps) can be entered.

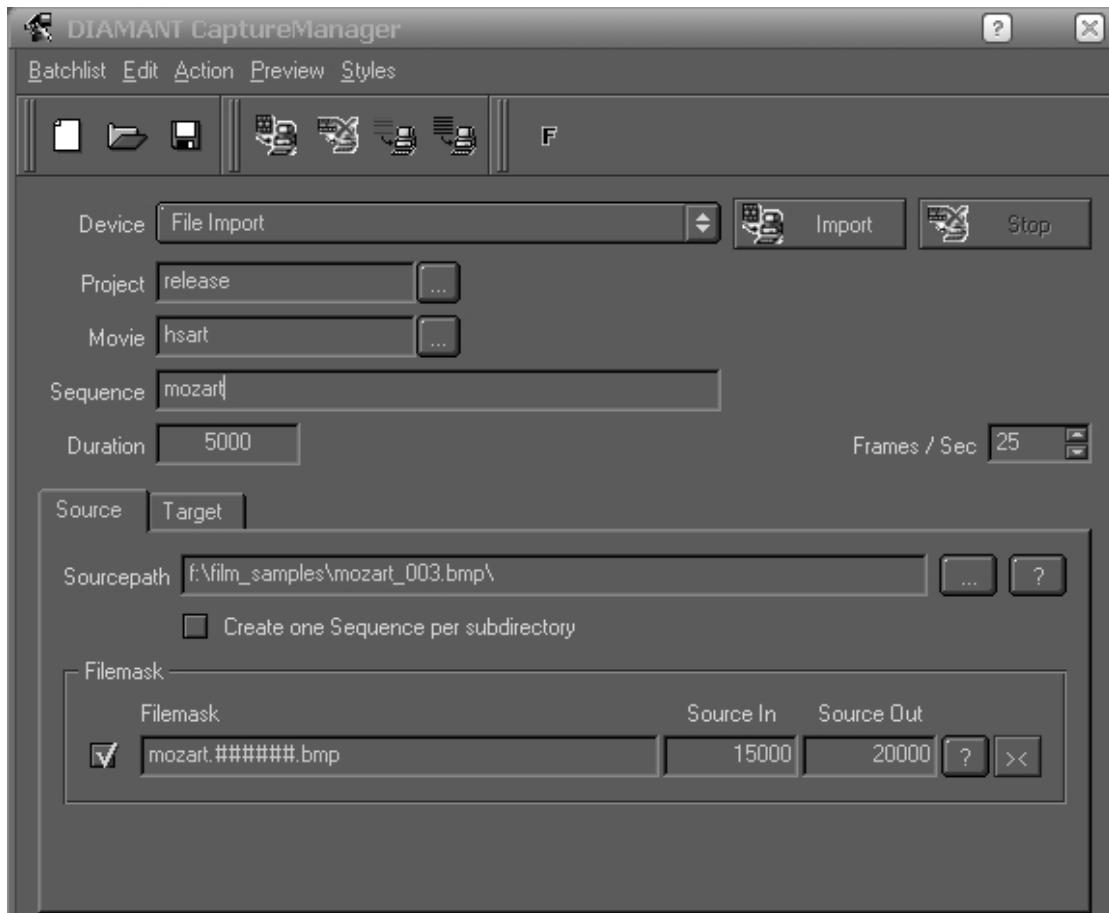
File import

This device is good for importing a sequence of single image files.

Source

- **Sourcepath**

Specify the source directory with the single images inside or one parent directory, if you want to import from several directories in one step.



- Create one sequence per subdirectory

By checking the “Create one sequence per subdirectory” option, it is possible to automatically scan all subdirectories of the selected folder and import each one’s content into a separate sequence.

- Filemask

DIAMANT must know the naming scheme of the input images, also called “filemask”, which consists of fixed characters and a frame number. Frame numbers can start from 0 or any positive number and must be consecutive. The number is represented by the “#” characters in the filemask. The number of “#” characters equals the number of digits.

DIAMANT can also automatically try to determine the correct filemask. If the source directory contains other files than the image sequence, this function will fail and manual entering of the file mask is necessary.

- Source in /Source out

Defines the first/last image of the directory that you want to have in the sequence. Usually these values are changed if you only want a part of the directory in your sequence. Keep in mind, that the recommended sequence size in DIAMANT is somewhere between 5,000 and 20,000 images. You can work with longer and shorter sequences, but the efficiency might be affected!

Changing these values, automatically adapts the setting for Duration.

Target

- Data volume

If more than one Data volume is available, the selector sets the target path for images and render results of this sequence.

- Use always same data volume

By default, the sequences are distributed over all available data volumes. By activating the checkbox “Use always same data volume”, you can force the import to the preferred data volume.

- Copy files

The option flag *copy files* is very important as it directly relates to performance issues. If the source directory of the image files is of steady nature, such that the original files will remain accessible until the preprocessing job is finished, it is not necessary to copy these files physically into the DIAMANT workspace (de-selected flag). If the flag is selected the files are copied physically, which should be used on non

permanent file systems like CDs. Use this option also when the DIAMANT render workstations do not have access to the source path.

- Drop images

You can drop images in a regular intervall if this option is activated. This is usefull when you have a regular pulldown and you want to suppress it during import. Be carefull when using this option as you might loose some images!

- StartTC

Defines the start timcode for the sequence. This information is preserved during restoration and when exporting it will be added into the first exported single image file, if the format supports timecode (e.g.: DPX). All following files get consecutive timecodes.

Start

Press the import button to start copying files and/or to create the new image sequence. The *Stop* Button cancels any running import processes.

The import is successfully finished, when the Stop button is deselected!

QuickTime import

This device is good for importing a sequence from a quicktime movie.

Source

- Quicktime movie

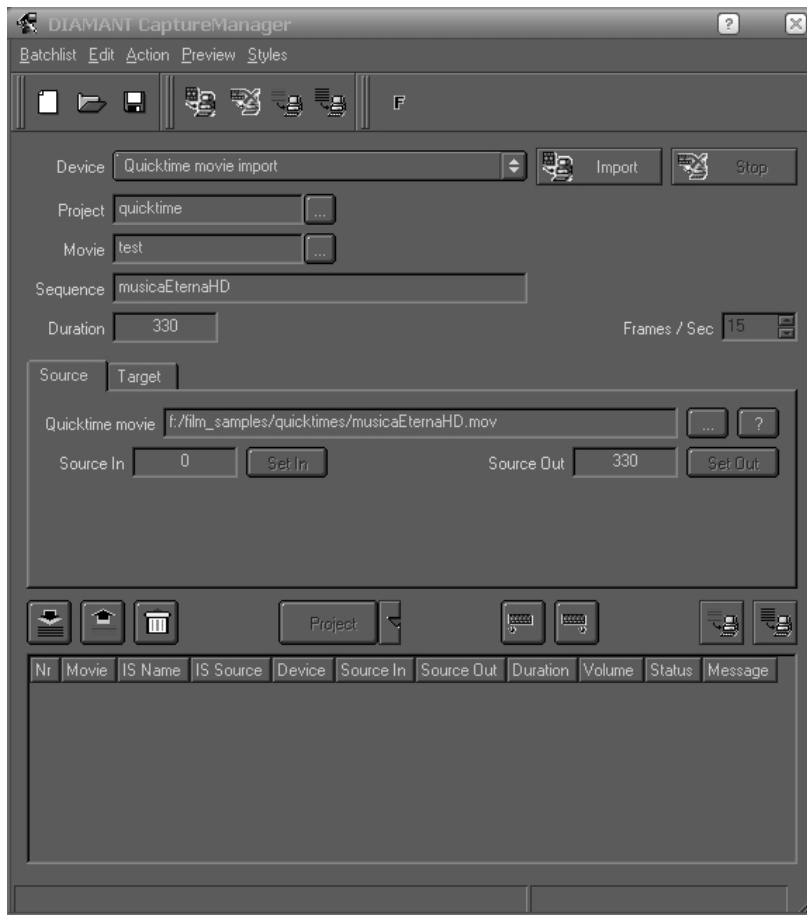
Specifies the quicktime movie, which should be takes as source for the sequence. After selection the first and last image in the movie is automatically extracted and proposed.

- Source in /Source out

Defines the first/last image of the quicktime movie that you want to have in the sequence. Usually these values are changed if you only want a part of the quicktime movie in your sequence. Keep in mind, that the recommended sequence size in

DIAMANT is somewhere between 5,000 and 20,000 images. You can work with longer and shorter sequences, but the efficiency might be affected!

Changing these values, automatically adapts the setting for Duration.



Target

- Data volume

If more than one Data volume is available, the selector sets the target path for images and render results of this sequence.

- Use always same data volume

By default, the sequences are distributed over all available data volumes. By activating the checkbox “Use always same data volume”, you can force the import to the preferred data volume.

- Extract images from quicktime

If the checkbox is activated, DIAMANT extracts all selected images of the sequence directly from the quicktime during import. As the import is blocking the operator has to wait on its completion, which might take a while if you work with long sequences. Use this option only when needed (e.g.: if your quicktime movie can not be accessed by the DIAMANT render workstations).

- StartTC

Defines the start timcode for the sequence. This information is preserved during restoration and when exporting it will be added into the first exported single image file, if the format supports timecode (e.g.: DPX). All following files get consecutive timecodes.

Start

Press the import button to start copying files and/or to create the new image sequence. The *Stop* Button cancels any running import processes.

The import is successfully finished, when the Stop button is deselected!

DDR import

This import mode requires a supported video device in disk-recorder mode (DDR).

Source, describes the position of the disk-recorder from which the images are imported. The specified segment is taken from the DDR location given by the DDR In and DDR Out timecodes.

After entering the appropriate timecodes, the import process can be started by clicking the “capture” button.

By clicking the PREVIEW button, a video window is opened, showing the current video image at the DDRs input. The transport controls can be used to control the attached VTR. In and Out markers can be set by clicking the IN and OUT buttons.

Epecially on networked systems, after clicking a transport control, a noticeable delay will occur until the VTR follows the command. Please be patient and wait until the VTR has reacted to the last command before clicking another transport control.

VTR import

This import mode requires a supported video device in disk-recorder mode (DDR). The video device is connected to a VTR via digital or analog video lines and a RS422 control line.

On the Source tab, the VTR In- and VTR Outpoint are entered as timecodes. The specified segment of the tape will be copied onto the DDR location given by the DDR In and DDR Out timecodes.


After entering the appropriate timecodes, the import process can be started by clicking the “capture” button.

By clicking the PREVIEW button, a video window is opened, showing the current video image at the DDRs input. The transport controls can be used to control the attached VTR. In and Out markers can be set by clicking the IN and OUT buttons.

Epecially on networked systems, after clicking a transport control, a noticeable delay will occur until the VTR follows the command. Please be patient and wait until the VTR has reacted to the last command before clicking another transport control.

3.1.4 Batch import

With all devices it is also possible to automatically import a *list* of sequences, which is called batch import. In this case, the section at the bottom of the CaptureManager window is used.

The sequences to be imported can be defined manually as described above. After making all necessary entries, instead of clicking the “Import” Button, the  button is clicked. The import sequence is now transferred to the batch import list.

To modify one entry in the batch list, select the appropriate line in the list and click the 2nd button from left. The selected item is transferred up into the entry area, where it can be edited and transferred back down afterwards.

After defining a number of sequences, the batch import process can be started by clicking the



button.

Project										
Nr	Movie	IS Name	IS Source	Device	Source In	Source Out	Duration	Volume	Status	Message
3 test	ME03			Quicktime movie import	0	100	100	PLATFORM_MP_VOL1		
4 test	ME04			Quicktime movie import	100	200	100	PLATFORM_MP_VOL1		
5 test	ME05			Quicktime movie import	200	300	100	PLATFORM_MP_VOL1		
6 test	ME06			Quicktime movie import	300	330	30	PLATFORM_MP_VOL1		

DIAMANT offers also an automatisisation for defining the sequences for batch import. This is especially usefull when working with long quicktime movies. You can use the special character “#” in the sequence name, followed by a number. Giving such a name and then sending it to the batch import list, creates a series of sequences. If you have for example a quicktime with 23,000 images and you want to import your sequences with a duration of 10,000 images you simply add to the sequence-name (e.g.: “testmovie”) the postfix “#02”, you change the duration to 500 and you send it to the batch import list. Therein you will immediately see 3 entries for 3 different sequences with the names “testmovie02”, “testmovie03” and “testmovie04”. Whereas the first 2 have a duration of each 10,000 images, the last “testmovie04” has a duration of 3,000 images.

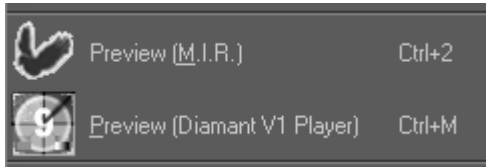
You can also use the “@” symbol in the sequence name if you want to use the directory name of the import source.

Another way of defining input sequences is by import of an Edit Decision Lists (.edl, .cmx) from an external software. Based on the information stored in the file, a corresponding batch import list is automatically created.

Batch lists can also be saved for later import by selecting “Save” from the “Batch list” menu.

3.1.5 Preview

Once you have your sequences imported in DIAMANT you might want to preview them in order to make a decision about the next restoration steps.



DIAMANT V2 provides 2 ways for previewing. First there is the traditional MoviePlayer that is still available from the context menu of the MovieManager. However this tool is available only for compatibility reasons and for operators that are already used to it. Therefore we have not included the documentation any more.

All new operators are advised to use the M.I.R. for previewing. M.I.R. is also available from the context menu of MovieManager. If opened in the preview-mode it provides fast and efficient re-play, but it can not be used for any manual retouching. Refer to chapter 0 for a detailed description of M.I.R.

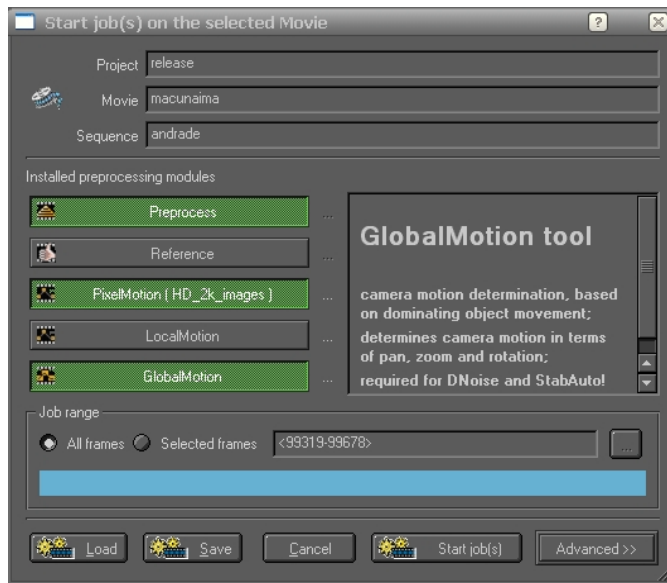
3.2 Automatic & control

3.2.1 Batch processing

Batch processing is the (fully) automated way of operation inside DIAMANT V2.

Any batch processing tool, can be applied on a full sequence, on a continuous range within a sequence or on several sequences at the same time.

To apply it on one sequence you just click right on the selected sequence and open the context-menu. Therein you select “Batch processing” and by following the dialog you can make your selections and start the processing.



To apply it on a continuous range within the sequence you need to do a similar approach, but before launching the processing you need to adapt the range values (start/end), so that the tool works only on those parts of the sequence you want. This is of special importance, should a batch processing have failed before, and you want to restart it on the failed segments only.

If you want to start a batch processing on several sequences at the same time you need to do a multi-select on sequences and then click right to select the right entry from the context-menu.

A convenient alternative is the selection of a whole directory entry in the left-side MovieManager window and then the selection of the context-menu by a right mouse-click.

The batch processing window offers the following tools:

- **Preprocess**

Needs to be completed before the RestorationManager can be started. Calculates preview resolutions, determines camera-changes and creates the temporal overview (=stripe-image). See 4.1.1 for more information.

- **Reference**

Determines reference images that are used for brightness correction (DFlicker). See 4.1.2 for more information.

- **PixelMotion**

This is not available with all installation, as the tool is an option. It is an alternative for LocalMotion and required to be run on any sequence before Dust and DNoise. See 4.1.4 for more information.

- **LocalMotion**

This is not available with all installation, as the tool is an option. It is an alternative for PixelMotion and required to be run on any sequence before Dust and DNoise. See 4.1.3 for more information.

- **GlobalMotion**

Tool for determination of camera movement. It is required to be run on any sequence before StabAuto and DNoise. See 4.1.5 for more information.

For any selected batch processing option (green colored) you can press on “...” to get a list of predefined parameter settings for the tool. If no one is selected than the tool is applied with default-settings.

Be careful with the selection of preprocessing modules, as calculation of some (e.g.: LocalMotion) is quite time-consuming. Therefore you should launch these options off-line, especially for longer sequences.

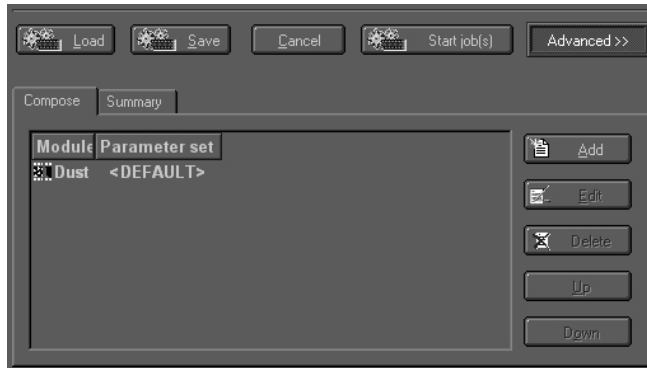
Advanced processing

Selecting the “Advanced>>” button will open the “Advanced processing” window.

The advanced-option provides a way for automatic restoration without initial interactive work. This is useful when you already know the characteristics of a movie and when you

have already determined a well suited process (=order of tools) together with optimised parameter-settings.

Just select the modules you want to apply on the sequence and start the job as usual.



- By clicking the “Add” button, the tool selection window is opened.
- Use the drop-down list at the top to select the desired module. After this, select one or more parameter sets from the list at the right side of the window. The selected module will be executed separately for each selected set of parameters.

You can define your own parameter sets in the RestorationManager or in the Configure section of MovieManager (see 0).

The “summary” tab provides a quick overview about the versions to be rendered.

Abort batch processing

You can abort any batch processing job from the MovieManager by accessing the context-menu of the sequence.

Suspend

Resume

Abort

Select all

Job-ID	xml-File	Progress	Frames	Sections	Start Frame	End Frame
4	job_release_whitelflood_o	0	0/3514	0/24	1	35

Render Node Actions

Central Workstation

Active Slots

DIA1 (192.168.1.199)

0/1

Selected render clients

Select all

Client-ID	Active Slots	
1	DIA2 (192.168.1.197)	2/2
2	192.168.1.198	2/2

Configure

Restart

SW Update

Self Test

Disk Performance

CPU Performance

Running Sections

	Job-ID	Section-ID	Progress	Start Frame	End Frame	Client	Module
1	4	1	0/101	1	228	192.168.1.198	Imotion
2	4	2	0/101	229	1040	DIA2	Imotion
3	4	3	0/101	1041	1256	192.168.1.198	Imotion
4	4	4	66/101	1257	1259	DIA2	Imotion

Pending Sections

	Job-ID	Section-ID	Start Frame	End Frame
1	4	5	1260	1460
2	4	6	1461	1684
3	4	7	1685	1839
4	4	8	1840	1960
5	4	9	1961	2036
6	4	10	2037	2088

Errors: 0

Show JM Log

Show Log

11:00:57: JobManager ready

11:00:57: Render Client DIA1 (192.168.1.199): Render Client is up and running

11:13:26: Render Client DIA3 (192.168.1.198): 192.168.1.198Render Client is up and running

11:13:40: Render Client DIA2 (192.168.1.197): 192.168.1.197Render Client is up and running

11:22:48: Job: job_release_whitelflood_original.xml - started

11:23:56: Job: job_release_whitelflood_interpolate_regrain.xml - started

11:24:02: Job: job_release_whitelflood_interpolate_regrain.xml - finished

11:24:40: Job: rmjob_release_whitelflood_R01_interpolate_regrain.xml - started

11:24:46: Job: rmjob_release_whitelflood_R01_interpolate_regrain.xml - finished

11:34:13: Job: job_release_whitelflood_original.xml - started

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3.2.2 JobManager

The DIAMANT JobManager collects all jobs and distributes them on the render-farm (render-clients). Usually, JobManager is started (together with the DDS server) at system startup and does not need any user intervention. However, a user interface is provided for administration and system monitoring.

Job Types

DIAMANT uses 3 different types of jobs:

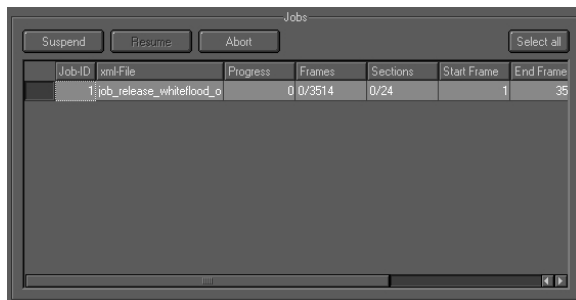
- **“Render one Frame” jobs**
Such jobs are generated by clicking the “render one frame” button in the RM and is a preview for one single image. This job has highest priority.
- **RM jobs**
Such jobs are generated by starting a semi-automatic restoration job from the RestorationManager (“render” or “render shot”).
- **Batch processing jobs**
Such jobs are created by MovieManager.

Control interface

The GUI is divided into several zones, each monitoring a certain aspect of the DIAMANT-Suite.

Jobs

The buttons in the upper left area of the GUI provide access to Job Control functions. Below there is a list of all running and recently completed/aborted jobs.



- *Suspend*
The selected job(s) will be suspended.
- *Resume*
Click this button to resume a

suspended job.

- *Abort*

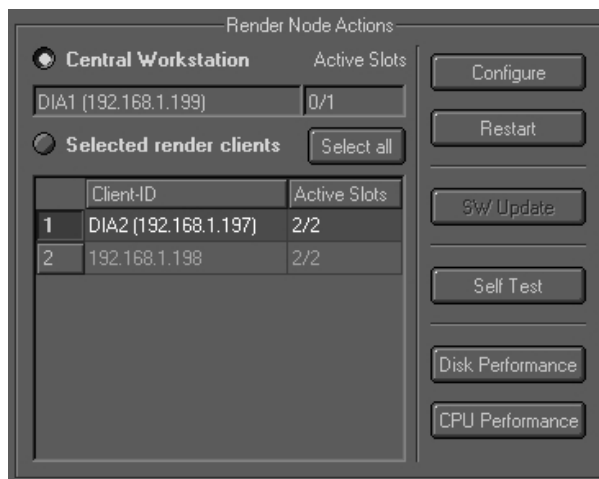
All running sections of the selected job(s) will be aborted, and the job is removed from the Job-list.

- *Select all*

The operator can either select single jobs for actions or he can select them all together by pressing this button.

All finished jobs are also visualised by a leading RestorationManager icon. Clicking on this icon opens the RestorationManager with the completed job.

Render Node Actions



The upper, right part of the interface gives an overview of the render-farm. Should you use DIAMANT on a single workstation only, then the list of render-clients is apparently empty. However in all cases there is at least one central workstation listed.

Both, the central workstation as well as any render client can be administrated with the following actions:

- *Configure*

Opens the configuration dialog for the selected render client(s). You can assign to any render client the type of jobs the client is

going to accept and also the maximum number of parallel jobs on the client. Usually you should deselect “one Frame” jobs on the render farm, this option needs to be selected on the central workstation only! If you use DIAMANT on single workstation only, you could also select the “Additional one frame slot” option.

- *Restart*

Stops and restarts the JobLauncher on the render client. Just to be used in case of troubles with the render client. Avoid this function while there are some running jobs!

- *SW update*

After installing an update of DIAMANT on the central workstation, the new software can be distributed to all render clients automatically. This process is initiated on all selected clients by clicking the “SW Update” button.

- *Self test*

Tests if the render client is reachable and if its configuration seems ok. This is not a gurantee for proper set-up but a good indicator. If you set-up your system or if you make any changes with the render-farm it is definitely an excellent idea to run this test, before starting render jobs.

- *Disk / CPU performance*

This is a measurement tool for evaluation the speed and efficiency of your hardware. If you measure Disk-performance you should select all render-clients simultaneously. This helps to mease the disk speed over network, which is definitely the major performance limiting factor if the speed is below ~20MBs.

Running sections

Running Sections							
	Job-ID	Section-ID	Progress	Start Frame	End Frame	Client	Module
1	1	1	0/101	1	228	192.168.1.198	Imotion
2	1	2	0/101	229	1040	DIA2	Imotion
3	1	3	0/101	1041	1256	192.168.1.198	Imotion
4	1	4	66/101	1257	1259	DIA2	Imotion

In the case of an idle system the list is empty, otherwise it shows you all sections (= parts of a job) that are under calculation.

Pending sections

	Job-ID	Section-ID	Start Frame	End Frame
1	1	5	1260	1460
2	1	6	1461	1684
3	1	7	1685	1839
4	1	8	1840	1960
5	1	9	1961	2036
6	1	10	2037	2088

Shows you the queue for rendering. If you start a new job, the job and its status is visualised in the Job-section. The JobManager divides any new job into parts (=sections) that can be processed in parallel. All such sections are inserted into the list of pending sections.

If the system is idle (=no running sections) and the pending section list is not empty you definitely have a problem. In most cases you do not have any available render clients to be served by the JobManager.

LOG and status feedback



- **Errors**

JobManager keeps an overall counter of all errors occurring in the system. The total number of occurred errors is displayed in the “Errors” button. Click the button to reset the counter to “0”. The counter is preferably used if you start longer jobs to give a quick overview if there were any errors or not!

- **Show JM Log**

This button opens the JobManager LOG-File. Use it only in case of errors.

- **Show Log**

This button opens the LOG-File to give you more feedback if an error occurred.

3.2.3 JobLauncher

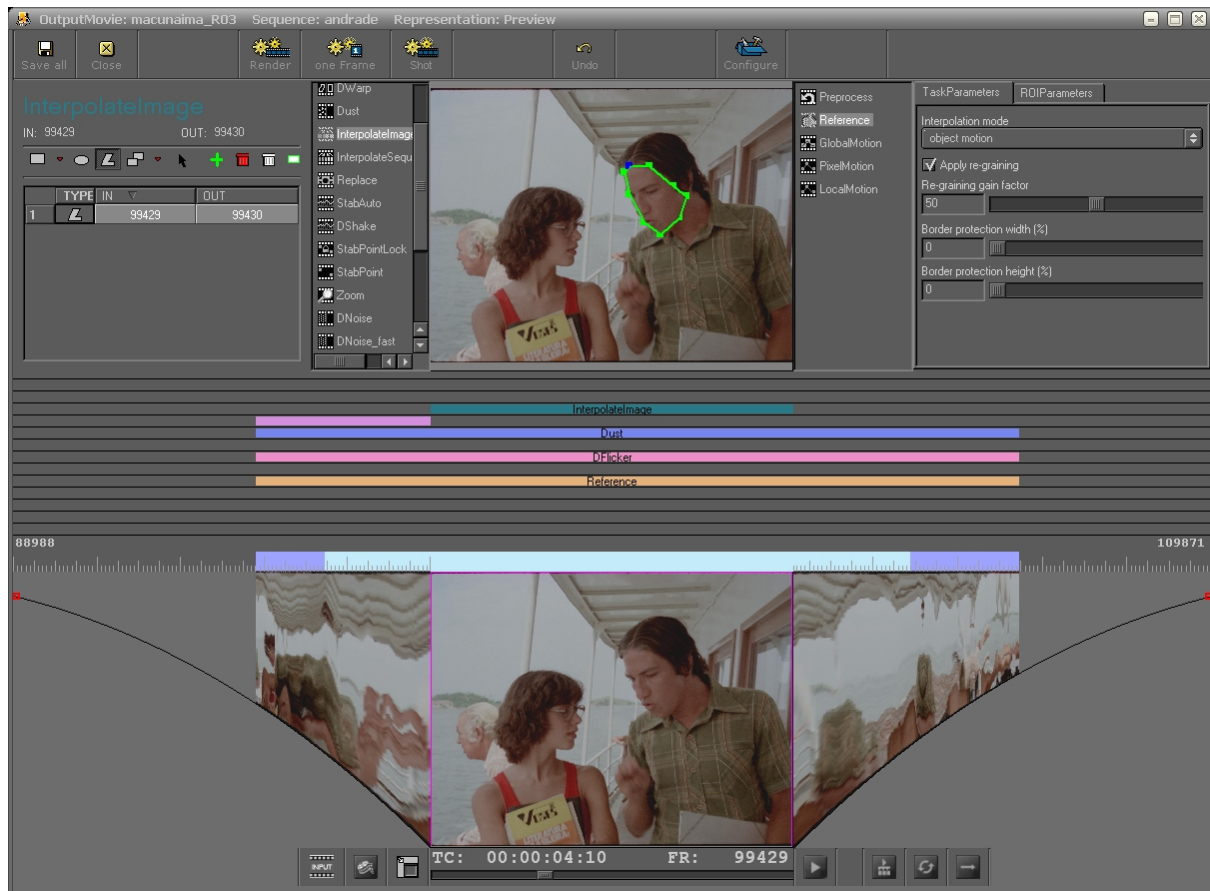
The JobLauncher is the application that controls the rendering. As already described in the JobManager section, there are 3 different jobs in DIAMANT (“One frame”, RestorationManager and “batch processing” jobs).

Usually there is no need for the operator to interact with the JobLauncher. The JobLauncher itself is started by Diamant-Start.

JobLauncher is the only DIAMANT application that needs to be available on each render workstation. The JobLauncher opens a communication channel to the JobManager, if the channel is well established you can see its entry in the JobManager. If there is an error you can have a look on the interface of JobMangaer. Usually it will provide you with a message that the JobManager could not be found.

Verify the IP-setting for the JobManager entry in the DIAMANT configuration and/or restart the JobManager to retry.

Please make also sure that the JobManager has the same view on the repository and data-paths as the JobManager. Otherwise some render-errors will be inevitable!



3.3 RestorationManager

RestorationManager, shortly RM is the application, which provides you with powerful functionality for semi-automatic restoration.

You open RestorationManager with a selected sequence from MovieManager. This sequence is considered as *source* (=original) and its contents are never changed.

Beside that, RestorationManager needs an additional sequence, called *target sequence*. This one is automatically created when launching the RestorationManager on a source sequence for the first time. For all future accesses the RestorationManager reads the source and corresponding target sequences.

You can decide if an already existing job should be re-used (“**use existing job**”) or if you want to start from the scratch (“**create new job**”).

If you experience problems opening a sequence, one possible cause could be a corrupted job file (e.g., after a system crash while the sequence was opened in the RM). In this case, use the “create new job” option to create a new job file.

3.3.1 Navigation controls

Source / Target window

RM contains 2 windows for visualisation of source and target sequence. Both windows are synchronised.

The bottom window usually shows the source sequence.

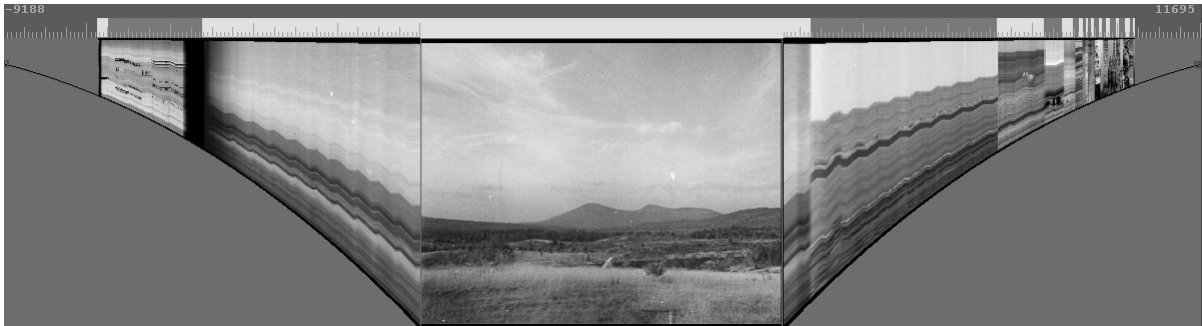
However for quality control issues you can also select any previous DIAMANT generation of the target sequence (e.g.: if your source sequence is _R01 and you did a DFlicker with source sequence Original, than you can select Original to see the difference between Original and _R01).

The upper window usually shows the target sequence. Before you haven’t started any rendering target and source are equal!

However, you can also show the mask as difference between source and target image or switch between source and target sequence to compare before-after restoration (use TAB). The target window can be made bigger (Ctrl+TAB) and eventually be put on a second monitor. This is especially usefull on any resolution bigger than SD.

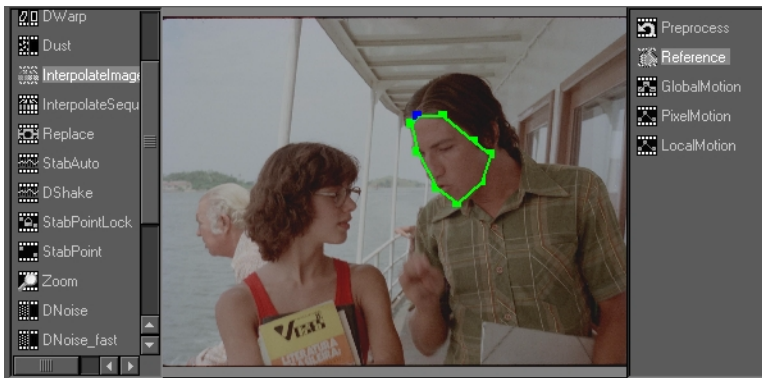
Imagestripe

This element gives a temporal, non-linear representation of the whole source sequence. You can influence the non-linear representation by the slider on the left side – thus you can stretch or compress the temporal domain according to your needs.



Module lists

This section provides you with a list of the available restoration modules. The modules offer the various restoration functions for defect concealment and sequence repair.



Available batch processing modules are indicated on the right side of the target sequence window. In most cases these tools will be applied in the batch processing, but if you experience that you need e.g.: motion information at a certain point of time, you can directly calculate it from the RestorationManager.

As the batch processing tools do not create and image data, they can be deleted from the job, after the job has been rendered for a first time. For example: if you do a GlobalMotion followed by StabAuto and then you want to change some parameters/settings of StabAuto, you do not need to recalculate

GlobalMotion. In such a case you can delete the tool from the job. As it has been calculated before, its data will be used in the second pass automatically.

Job definition section

The job definition section provides you with room for the definition of restoration jobs. You can select appropriate tools from the module lists located beside the target window. Just drag them down to one line of the job section.

To select a tool of a job, you just have to click-left on the tool's line. Clicking-right shows you the context menu of the tool.



Be aware that the restoration jobs are always rendered as a projection from source to target window (i.e.: bottom-up, so that PixelMotion comes before Dust, as in the sample above). Each tool comes along with a default length.

For changing any tool's start and end-point in temporal domain you have to go to the desired position, select the tool and then press a key to indicate that the tool should start/end at this position (currently it is "k" for in-point and "l" for out-point). Press Ctrl+Del for deletion of a selected tool.

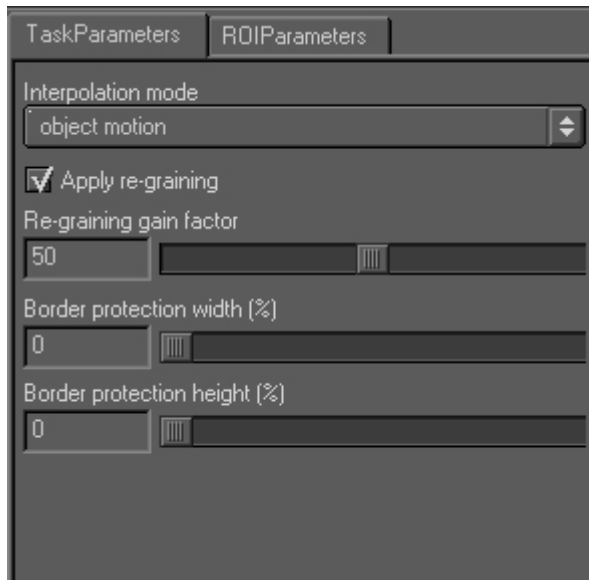
We have chosen "k" and "l" as they are below "i" and "o", which define in- and out-point of the render-range.

Be aware that the marked out-point is never included into the tools range!

Tool options, parameter-settings

Only one tool can be selected at a certain point of time (Just click on the tool. Descriptions and settings of this tool are visualised in the tool option window.

As each tool comes with different options and settings you have to refer to the reference description (chapter 4) for details.



The tool option menu consists of 2 parts, one for the parameters the second provides detailed information of used regions and is rarely used.

You can save and re-load specific parameter-sets (tool options), by using the context-menu of the tool.

To save the current settings of a module, right-click the module and select "Save" from the context menu. Enter a name for the new parameter set and click "OK". If you enter the name of an existing parameter-set, it will be overwritten with the current settings.

To load an existing parameter set, click-right on the module and select "load" from the

context menu, and click on the desired parameter set.

By selecting "Reset parameters" in the context menu, you can reset the module parameters to the default values. These values are stored in the parameter set named <DEFAULT> and can be changed by overwriting this set.

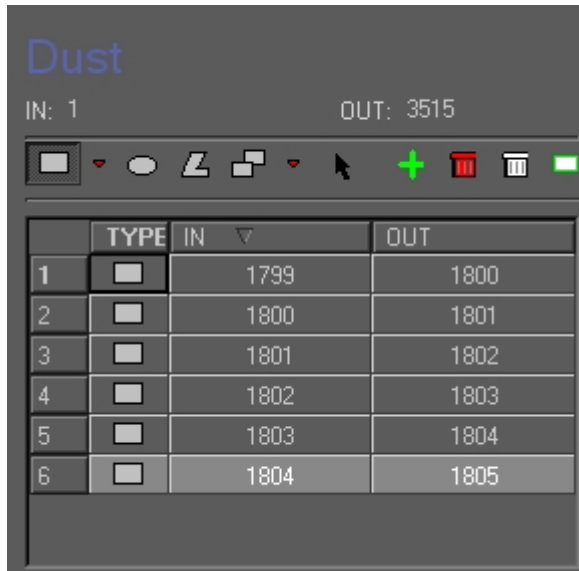
All parameters of a task (module settings, ROIs, point lists etc.) can be transferred between modules through the "copy" and "paste" commands in the context menu. Select "Copy" to copy the complete task parameters into the clipboard. Select "Paste" on the target module to paste any of the tasks parameters.

Marked regions (ROI's)

During restoration, it is often necessary to restrict operations to a certain area of the image. For this purpose DIAMANT offers the so called "regions of interest" (ROI). Each tool can have a list of (different) ROIs.

A ROI is a specific region (ellipse, rectangle, polygon, animated) which selects parts of an image. Selection can be done *positive* (green), which means everything within the ROI is selected or *negative* (red), which means everything outside of the ROI is selected.

Each ROI has it's own start and end. Depending on the selected module, the default length of the ROIs will either be one frame (e.g.: Dust, Interpolate) or the length of the module (e.g.: DNoise, Zoom). To manually set the in- and out-points of a ROI, click and type into the respective field in the ROI list window.



You can define several ROI's within one task, but you can not mix positive and negative selections!

To delete a ROI, either select the ROI and press the "DEL" key, or select the ROI's and then click on the waste-bin (the red one deletes all ROI's, the red one just the selected ROI's). Undo brings them back!

ROI parameters

They can be accessed in the upper-right window. The "Border" value defines the blending width for the transition between the selected and non-selected image areas. A value of 0 means that there is a hard cut, whereas bigger values lead to a smooth blend.

Animated ROI's

This feature allows the selective region to move throughout the image, thereby following any objects. This can be used for example to exclude an object from processing (e.g.: DNoise only on the background of an image).

A special drawing tool is provided to create animated regions. Klick the drop-down arrow on the left side to select the type of region.

Every time the shape is moved to a different position, this position is saved in a keyframe list. Later during the render process, the shape's position is interpolated between the keyframes.



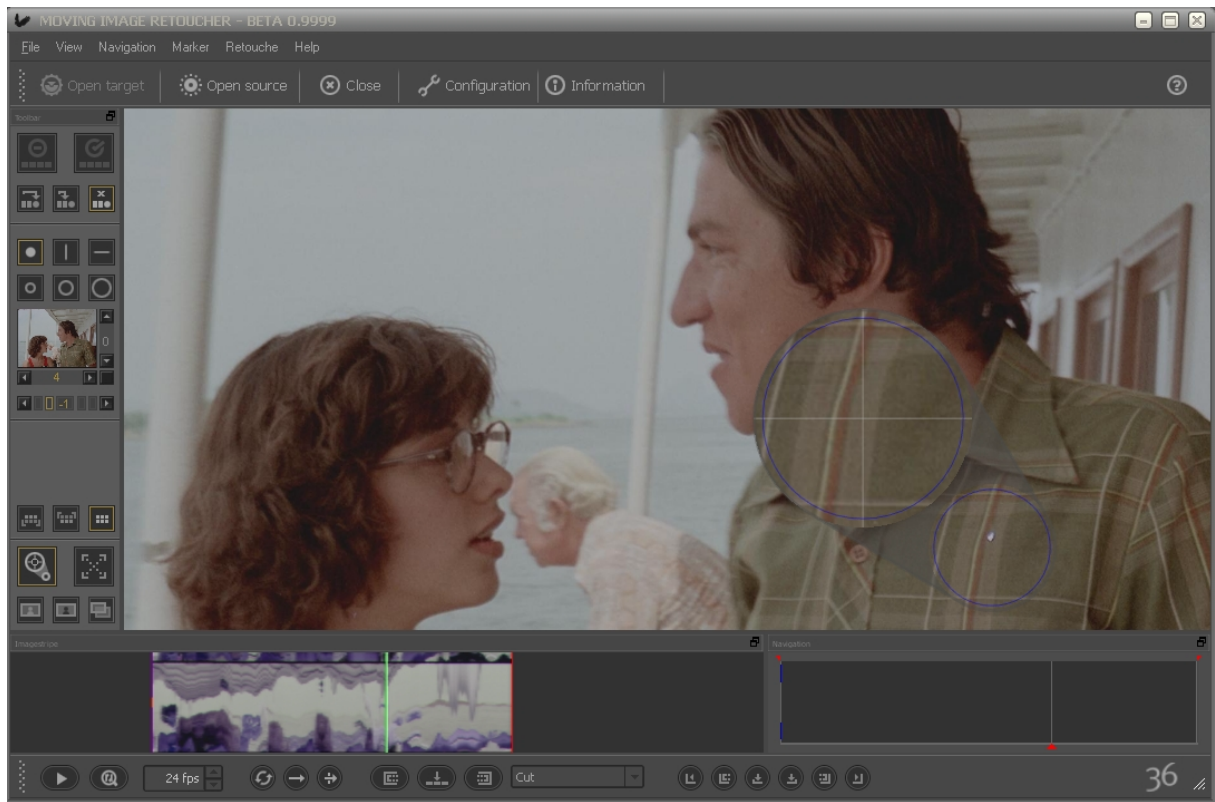
After selecting the required type of region, draw the initial position into the first image of the target sequence.

Move forward a few frames until the object moves out of the marked region.. Now use the mouse to re-position the ROI in the current image.



If you continue like that you are able to track your object quite easily. You will quickly learn that you best do your adjustments when changes in the movement of the object happen.

After definition the region will automatically track the object when stepping through the sequence. On a keyframe, the ROI is shown in purple color. On all other images, the ROI is shown in red or green (depending if it is exclusive or inclusive).



3.4 M.I.R. – Manual Retouch

Tool for manual retouch and repair of movie sequences. M.I.R. is the optimal environment for manual retouching and finishing almost any restoration project.

All issues, that could neither be solved by application of automatic filters nor by support of the semi-automatic interface from the RestorationManager could be addressed.

3.4.1 Principles of operation

M.I.R. principally works with 2 sequences. The first is called foreground sequence and is the source for repair, the second is background and holds the retouched images. It is possible to use the same sequence as foreground and background.

For fast viewing the operator can focus on either foreground or background sequence, which permits fast playback. Additionally the operator can use the so called MicroLoop for cyclic RAM-replay around the current image. When stoping the MicroLoop, the operator is automatically back at the same image from where he started MicroLoop.

However the main purpose of M.I.R. is retouching. For that M.I.R. offers a brush with several types (circle, elliptical with horizontal and vertical focus). Those brush-types can easily be changed with support of keyboard and mouse. Whereas circle typed brushes are good for removal of regular particles like dust, the elliptic brushes are very helpful to repair linescratches, etc.

Working with the brush in an image is like erasing information from the target (=foreground), leading to the display of source sequence information in the “brushed” regions. Should the operator have been too aggressive with the brush, he has the UNDO-resp. healing-brush available with the pressed right mouse button. The result of a brush-application is a so called mask.

Monocle is a specific, patent pending, tool for supporting the repair process. The Monocle consists of 2 parts, one showing the brush and the second showing the content of the source that would be revealed when applying the brush. This kind of preview is very helpful, just play around to get a feeling for it.

The operator can display the mask only, or he can apply a blening resp. ghost-mode; whatever he is best used to. Should the operator find, that the created mask is a mess, he can

clear it anytime. The background can be changed in spatial dimensions (x, y) as well as temporal dimension. For spatial offset there is an Auto-Alignment function, that permits automatic alignment between foreground and background.

When satisfied the operator has to confirm resp. fix the image. This results in storage of the target image.

3.4.2 Starting M.I.R. from DIAMANT

M.I.R is available in MovieManager as a tool on any imported sequence. If you select the context-menu of your sequence (click-right) you have 2 choices for using M.I.R.

Preview (M.I.R.)

Permits fast visualisation of the sequence. Retouching is disabled and can not be accessed. We recommend to use this mode for quality control purposes.

Retouch (M.I.R.)

Opens the M.I.R in retouch mode. The selected sequence is taken as retouch source sequence and the same sequence in the next DIAMANT generation is taken as target sequence. If the next DIAMANT generation does not exist it is created at start-up time of M.I.R. All retouched images are stored in this target sequence.

Open source

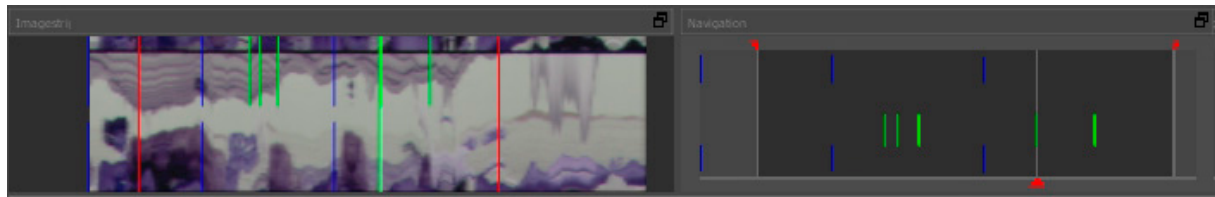


Command for opening a different DIAMANT generation as background.. In combination with the **Show target** / **Show source** / **Retouch** function, you can simply compare between two different versions!

3.4.3 Operating M.I.R.

Navigation & visualisation

Temporal position



IMAGESTRIPE shows you the environment of your current position, whereas *NAVIGATION* permits you to change your temporal position in the full duration of the sequence. Be aware that *NAVIGATION* always represent the full sequence length, whereas *IMAGESTRIPE* represents only the closer environment of the current position!

Information about used In/Out-point is visualised as red vertical line, blue lines show the camera changes, yellow shows temporal bookmarks and white lines indicate evidence of reference markers.

Keyboard: *Pos1 resp. End for start/end of the sequence;*

Ctrl+ ←/→ jumps to previous/next marker;

Mouse: *drag/drop the red pointer in NAVIGATION resp. double-click or drag/drop inside IMAGESTRIPE*

Monocle and Brush



This is a highly usefull tool that makes M.I.R. a unique application in the market.

The Monocle shows the content of the reference image to be filled into the current position in large scale (1:1). So you get an immediate preview of what you are going to do. You can move the source image in time and space to preview what you would fill in at the Brush position.



Interaction: *<mouse-left> to apply brush;*
 <mouse-right> to undo brush;
 Shift+<mouse-wheel> changes the size of the brush;
 Ctrl+<mouse-wheel> changes size of Monocle;
 V switches the Monocle on/off;
 T, X, Y + <mousewheel> moves the source image in time, horizontal and vertical
 A makes automatic adjustment for horizontal/vertical displacement.

Reset window



You can zoom into your movie any time by operator interaction. If you feel lost and you want to reset the visualisation state you simply select this button.

Interaction: *<mouse-wheel> to zoom in/out*
 Esc is a stronger reset, it also resets mask and source image.

Blend – Mask – Ghost mode



In M.I.R. you usually work with source and target images. When repairing your brush creates a mask, to reveal the content of the source image into the target image. You can blend source and target to show both images at the same time, but you can also just visualise the mask or show the difference between both images (=ghost mode). Please choose according to your preference.

As blend- and ghost-mode require specific hardware features from your graphic-card, it might happen that there is no visible effect. In such cases you need to change to a better performing graphic-card.

Interaction: *Ctrl+B for switching to blend mode ;*
 Ctrl+M for showing the mask;
 Ctrl+G for switching to ghost mode

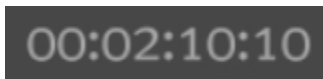
Navigation bar



Offers some possibilities for quick navigation. You can jump to First-/Last image, to In- and Out-points as well as to previous/next marker (of the active type). For example: if you have selected the marker type Cut you can jump to previous/next Cut.

Interaction: *Ctrl+← resp. Ctrl+→ for jump to previous/next marker;*
 Ctrl+i, resp. Ctrl+o for jump to In- Out-points;

Timecode / Image number



Visualisation of the current position. You can also edit the widget to jump to a specific position or toggle between display of timecode and image number.

Interaction: *<mouse-click> for change between timecode and image number display;*
 Ctrl+<mouse-click> for entering a specific timecode/image number by keyboard.

Operation modes

M.I.R. can be principally used for visualisation (playback) purposes and for retouching purposes.

Show foreground / Show background / Retouch



If you want to use M.I.R. for display-only purposes, there is no need to load, both – the background and the foreground images, as this creates unwanted overhead and disk I/O.

The first button displays only the foreground images, the second shows only background whereas the third shows both. The latter is also the mode where you can do retouch (working with brushes,...).

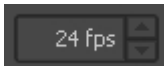
This functionality makes very much sense in combination with the “Open source” feature, as you can load any previous generation or version as retouch source or simply to compare different versions.

Interaction: *Ctrl+F for switching to full screen mode and back;*

Visualisation (playback)**MicroLoop**

Usually you can use play/pause like commonly used. Additionally M.I.R. offers the so called MicroLoop function, that displays the images around the current position in real-time. So you can judge your retouch-effects and when you stop the MicroLoop you are automatically back on the image where you started. This function is very convenient as it guarantees you (almost resolution independent) real-time visualisation at one click and after judgement you are automatically at the right position to continue your retouch job.

*Interaction: Spacebar for Play/Stop;
 Ctrl+Spacebar for MicroLoop;*

Playback speed

Defines the proper playback speed for the sequence. If your (hardware) fileservice is fast enough the sequence will always be played with this rate. If your fileservice provides images at a lower rate than the settings of **Play all** /

Play real-time apply.

Loop / Play all / Play real-time / Bounce at marker

There are two different loop-modes available. One is a cyclic loop and the alternative choice is bouncing between in- and out-point.

If your hard-disk is not fast enough to provide the right frame-rate for playback M.I.R. can either drop single images to manage the real-time requirement or the display is slowed down to match the frame-rate from the disk. For retouching purposes you will usually prefer the **Play all** setting, as you want to make sure that each image is properly corrected.

The third button defines the behaviour at markers. You can force M.I.R. to bounce at the active marker-type or to bounce at in-/outpoints.

Set In-/Out, Set Marker

The In- resp. Out point marks the active part of the sequence. Usually In- is the first image and Out- is

the last image in the sequence. However you can simply shorten that by setting these points. Just press the proper button and an In-/Out-point is set at the current position.

Markers in M.I.R. may have several types. Currently there are Cuts (=camera changes), References and Bookmarks. You can only have one type active in the moment. The active marker-type is selected in the pull-down menu. All further marker-commands refer to the active marker-type only. The most important marker-command is the Set/Unset function.

Interaction: M sets the selected marker type at the current position;

C sets a cut at the current position;

R sets a Reference at the current position;

B sets a Bookmark at the current position;

I resp. O sets in resp. out points;

Retouching

Fix / Clear



When retouching the result is stored in a “mask”. This mask defines which area of the current image is affected. When you are finished with one retouch action you have to confirm it by the Fix function or you can Clear the mask and drop your action. Be aware that the Fix function results in a definite change of your target sequence.

Keyboard: F to accept mask and fix the image;

G to accept mask, fix the image and move forward to next image;

Del to clear mask;

Fix mode



Settles the behaviour of M.I.R. after doing a fix. You can automatically jump to next marker, to the next image or stay at the current position.

Brush type



M.I.R. currently offers a freely configurable brush. However for a quick start you can simply select the favoured brush type (circle, vertical, horizontal)

and adapt it further. Any brush in M.I.R. has soft-border. The softness can be changed in the configuration menu.

Keyboard: Ctrl+1, 2, 3 to select brush type;

Brush size



There are 3 differen pre-defined brush sizes available. You can also change the brushsize to any desired size by operator interaction.

Interaction: 1, 2, 3 to select brush-size;

Retouch source



Defines the background. It can be defined with a spatial offset and a temporal shift.

Spatial offset is defined and edited with the numbers around the icon image (in the sample we have -4 pixels horizontal and 0 pixels vertical). The lower right corner offers a quick reset.

The lower line defines the temporal offset in images relative to the current position (in the sample -1 means the image before the current image).

Auto-Alignment

The Auto-Alignment function provides an automatic adjustment of the background image. It can be invoked any time by pressing "A". The current tool-position is than automatically matched with the background image and the background image is shifted in order to give the best match for the retouch tool. However, there is a maximum shift that can be edited in the M.I.R. settings (Configure). For big corrections (more than 25 pixels offset), it is recommended to adjust the position roughly by manual interaction and then do the fine-tuning with Auto-Alignment.

Interaction: W previews what you would fill I when using the brush;

T, X, Y + <mousewheel> moves the background in time, horizontal and vertical

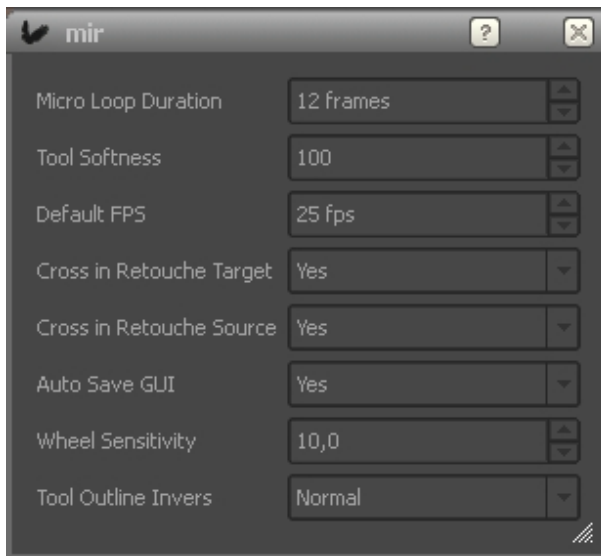
A automatically adjusts the background in horizontal/vertical position;

Alt+<mouse-left> moves the source image;

Ctrl+<mouse-left> moves the target image;

3.4.4 Configuring M.I.R.

You can personalise M.I.R. to match it to your personal preferences and needs. The configuration dialog can be simply accessed by pressing the “Configuration” tab.



The most important issue for changes might be the Wheel Sensitivity. The reason is, that different mouse drivers have a different behaviour.

Thus you are invited to adapt the wheel sensitivity to your personal needs. Just add a value of your choice, close the dialog and try.

Repeat that until you are satisfied.

Short cuts, Keyboard



Also we have tried to make a commonly useful setting you might want to personalise some of the short-cuts. Please select from the *Help* menu the “Define Shortcuts” entry.

There is a convenient dialog to personalise your short-cuts.

Use reserved words for function keys (e.g.: Ctrl, Alt, Tab, Shift,...) to address them. You can also apply “Reset to factory Settings” if you are lost.

3.5 Exporting and finishing

3.5.1 Export

Device

The device to which the sequence should be exported needs to be specified and influences the dialog.

Project / Movie / Sequence

In order to export a sequence you have to select project / movie and sequence.

Duration

The duration indicates the length of the sequence, either in number of frames or as time-code dependent on your preferred setting. Be aware that this value is usually automatically determined from the device dependent settings for Source in/out. However if you decide to set the Duration manually, than Source in/out are adapted to match this setting!

Frame rate

Optionally, the number of play-rate (fps) can be entered.

File export

This device is good for exporting a sequence as single image files to a directory.

Source

- Representation / Level

You can select if you want to export from the uncompressed data (HighRes) or from the preview (JPG). Additionally you can define the source size of the sequence. If you want best quality in the end you should select HighRes and the best resolution offered. Nevertheless you can specify the final target size of your exported files in the Target-section.

- Source in /Source out

Defines the first/last image of the sequence that you want to have exported. Usually these values are changed if you only want a part of the sequence in your directory.

Changing these values, automatically adapts the setting for Duration.

Target

- Targetpath

Specify the directory for the exported files.

- Filemask

You can define the naming convention for the exported files. Any exported file looks like: <prefix><number>.<format>.

As an example

```
prefix=movie1_  
number=variable  
format=DPX
```

results in exported files like "movie1_1.dpx" ,.., "movie1_10.dpx" ,....

Whereas number=#### would result in "movie1_0001.dpx" ,....

- First file number

You can enter a specific first file number, otherwise the file numbers are taken from the imported sequence.

- Scale images to

You can enter a desired resolution of the images. This option will make the export taking considerably more time, as each image needs to be resized. Be aware that selecting here a larger resolution than in the Source-Level option results in blowing up the image.

Start

Press the export button to start. The *Stop* Button cancels any running export process.

The export is successfully finished, when the Stop button is deselected!

QuickTime export

This device is good for importing a sequence from a quicktime movie.

Source

- Representation / Level

You can select if you want to export from the uncompressed data (HighRes) or from the preview (JPG). Additionally you can define the source size of the sequence. If you want best quality in the end you should select HighRes and the best resolution offered. Nevertheless you can specify the final target size of your exported files in the Target-section.

- Source in /Source out

Defines the first/last image of the sequence that you want to have exported. Usually these values are changed if you only want a part of the sequence in your directory.

Changing these values, automatically adapts the setting for Duration.

Target

- Quicktime movie

Defines the target quicktime movie. If the movie file does not exist a new movie file is created, otherwise an existing movie file is updated.

- Convert to encoding type

Quicktime offers various encoding types. So far we support only a few of them. Should you for any reason need a different encoding type, please let us know.

In most cases there is no need to do a conversion.

Start

Press the export button to start. The *Stop* Button cancels any running export process.

The export is successfully finished, when the Stop button is deselected!

DDR export

This mode requires a supported video device in disk-recorder mode (DDR).

Source describes the sequence or part of the sequence to be exported. Compare the File export device for that.

Target is always the DDR, but you can specify to which position of the DDR you want to export:

- **Use Mirror point** means that the DDRs frame storage is divided into two areas. At the beginning of the frame storage, the original (dirty) images are stored. After the Mirror Point, the rendered (clean) images are stored. Thus it is possible to switch between original and restored images quickly by queuing back and forth on the DDR.

As this concept results in a loss of disk recorder usage you can disable the Mirror Point in the DIAMANT configuration.

- **Use Target TC / Target TC**

Means that you export to a specific timecode of the DDR. Be aware that with this option the operator is responsible for administration of the DDR content. You could overwrite any position of the DDR.

VTR export

This mode requires a supported video device in disk-recorder mode (DDR) and an attached VTR, controllable by RS422 via the DDR. The sequence is first transferred to the DDR disks. In a second step, the attached VTR is activated and the sequence is recorded onto tape.

Source describes the sequence or part of the sequence to be exported. Compare the File export device for that.

Target is always the VTR, but you can specify to which tape-position you want to export. By default, the sequence will be put onto the same timecode where it was captured from. It is possible to specify a different location by entering the appropriate timecodes in the entry fields.

Advanced provides additional options as settings of the DDR that is used as intermediate storage for the transfer between VTR and DIAMANT.

- **Use Mirror point** means that the DDRs frame storage is divided into two areas. At the beginning of the frame storage, the original (dirty) images are stored. After the Mirror Point, the rendered (clean) images are stored. Thus it is possible to switch between original and restored images quickly by queuing back and forth on the DDR.


As this concept results in a loss of disk recorder usage you can disable the Mirror Point in the DIAMANT configuration.

- **Use Target TC / Target TC**

Means that you use a specific timecode of the DDR. Be aware that with this option the operator is responsible for administration of the DDR content. You could overwrite any position of the DDR.

3.5.2 **Batch export**

With some devices it is also possible to export a *list* of sequences, which is called batch export. In this case, the section at the bottom of the CaptureManager window is used.

The sequences to be exported can be defined manually as described above. After making all necessary entries, instead of clicking the “Export” Button, the  button is clicked. The sequence is now transferred to the batch list.

To modify one entry in the batch list, select the appropriate line and double-click on it. The selected item is transferred up into the entry area, where it can be edited and transferred back down afterwards.

After defining a number of sequences, the batch process can be started by clicking the



button.

Batch lists can also be saved for later export by selecting “Save” from the “Batch list” menu.

4 Tools

Any tool available in DIAMANT falls into one of 3 major categories:

- Analysis tools

Their main characteristic is automatic analysis - such tools never create any new (restored) images. Usually those tools are accessed by “Batch processing”, however most of them are also available in the RestorationManager.

- Restoration tools

These tools create new, restored images, available as new (red-colored) sequences in the MovieManager. Restoration tools are usually applied in the RestorationManager, however for automatic restoration they can also be used in the “Batch processing”.

- MovieManager tools

These are tools not directly related to restoration. The tools are usually available from the context-menu of the sequence in the MovieManager. You always get the context-menu of a sequence, by right-mouse click on the selected sequence. Applications like M.I.R and TimeStretch are such typical tools.

4.1 Analysis Tools

4.1.1 Preprocess

Required: needs to be calculated on any sequence before starting RestorationManager

Preprocess creates a multiresolution preview (JPG-format) sequence, determines the position of camera changes (cuts/shots) and creates also a temporal summary of the sequence (called stripe-image).

Preprocess works in a fully automated way and is also very fast.

Settings

There is no, but the default setting available.

Usage

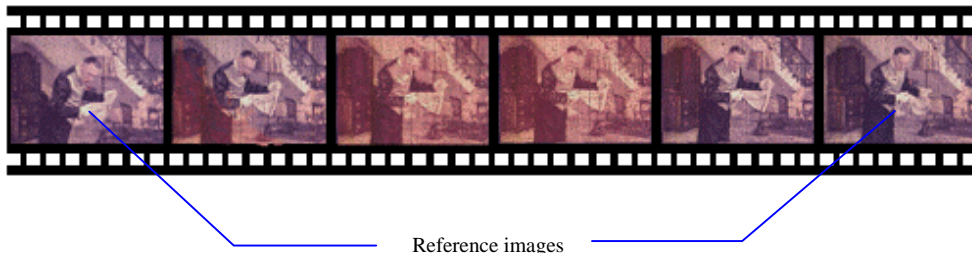
The tool needs to be run once on any sequence, that you want to use for restoration. If you only work with MovieManager tools, it is not necessary.

The operator can overrule the detected camera changes by pressing “c” for CUT in the RestorationManager.

4.1.2 Reference

Required: the tool's results are used by DFlicker and can be manually overruled in the RM.

This tool is an automatic tool for the determination of Reference images. Currently only reference images for DFlicker are determined. As the tool in most cases do not require any specific parameter setting it is highly recommended to start it from batch processing.

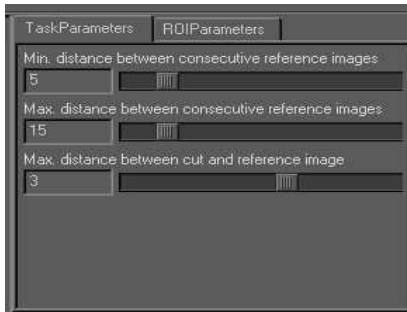


The tool analyses the histogram of each individual image and selects those images as reference that make best use of the available spectrum. The more reference images are available for a sequence, the better the quality of the later DFlicker correction will be.

Thus the most important characteristics of reference images is their distance among each other. A typical value is apx. 1 reference image between 10-30 images. As a general rule, action content requires significantly more references than static shots.

Settings

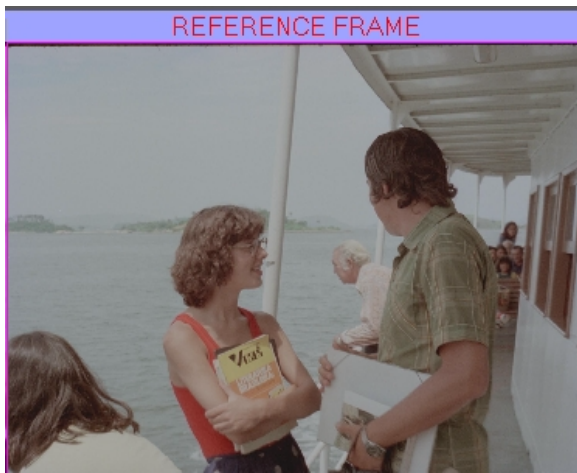
Although the default setting should be good for most cases, some difficult flicker-problems might require a revision. The main values are minimal and maximum distance between 2 consecutive reference images.



Usage

Once Reference is calculated you see all identified reference images by “REFERENCE” in the RestorationManager. You can then manually revise the findings (press “r” to add/remove references images) and view them by jumping from one to the next reference image (press Ctrl+Shift+”→” resp. Ctrl+Shift+ “←”).

As there are usually sufficient proposals for reference images, you should favourable delete those reference images (press “r”) that do not fit to the others. This interactive verification step is advisable, especially if you have a high degree of flicker in your sequence.



Should you have used Reference directly from the RestorationManager, it is wise to delete the tool after successful calculation. You can do this, because the results are anyway stored on a different place and if you would re-run it again, the tool would overrule any of your manual Reference adaptations you have made!

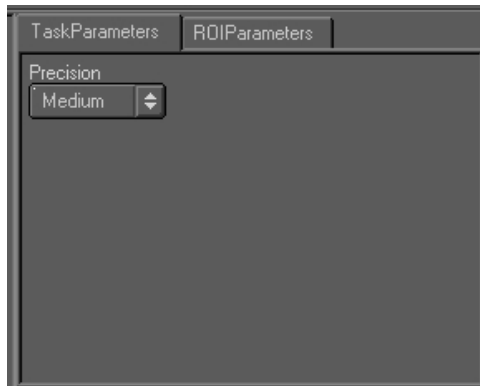
4.1.3 LocalMotion

Required: LocalMotion or! PixelMotion need to be calculated before Dust and DNoise

This is the traditional tool for motion analysis in Diamant. For motion estimation a feature matching is used, that finds for each pixel inside an image the corresponding pixels in the previous and following images. The process is fully automatic, but highly time-consuming.

Settings

There is only one configurable setting with the tool. It is called precision and it defines if and to which level a subsampling is used to speed up the analysis-process.



The recommendation is to use the best precision (=high) for all image resolution below 1k, the default-value (=medium) for HD and 2k. For 4k and even larger resolution we recommend to use the weakest setting (=low).

Usage

We recommend to use the tool in batch processing for off-line rendering as the tool is quite time-consuming. However you can also use it when there is need for it, directly from the RestorationManager.

Like any analysis module you need to run it only once. Meaning if you use it from the RestorationManager you can delete it after the first round of calculation.

4.1.4 PixelMotion

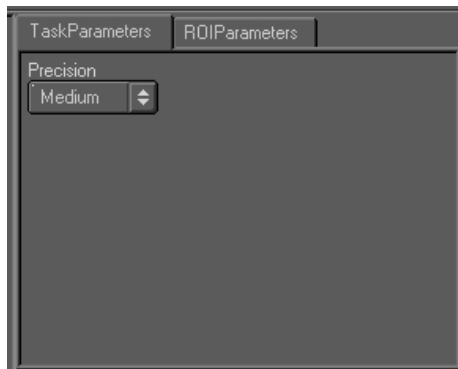
Required: LocalMotion or! PixelMotion need to be calculated before Dust and DNoise

This is a new, optional tool for motion analysis in Diamant. The motion estimation is based on optical flow and finds for each pixel inside an image the corresponding pixels in the previous and following images.

The process is fully automatic, the results are compatible with LocalMotion, but calculation is significantly faster.

Settings

There is only one configurable setting with the tool. It is called precision and it defines if and to which level a subsampling is used to speed up the analysis-process.



The recommendation is to use the best precision (=high) for all image resolution below 1k, the default-value (=medium) for HD and 2k. For 4k and even larger resolution we recommend to use the weakest setting (=low).

Usage

We recommend to use the tool in batch processing for off-line rendering as the tool is quite time-consuming. However you can also use it when there is need for it, directly from the RestorationManager.

Like any analysis module you need to run it only once. Meaning if you use it from the RestorationManager you can delete it after the first round of calculation.

4.1.5 GlobalMotion

Required: need to be calculated before StabAuto and DNoise

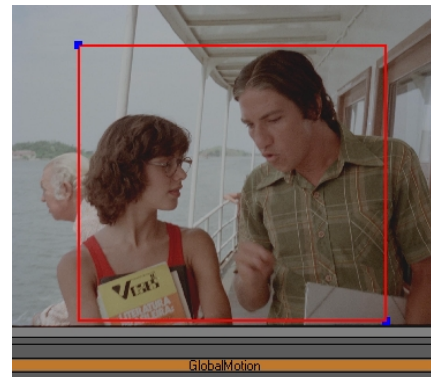
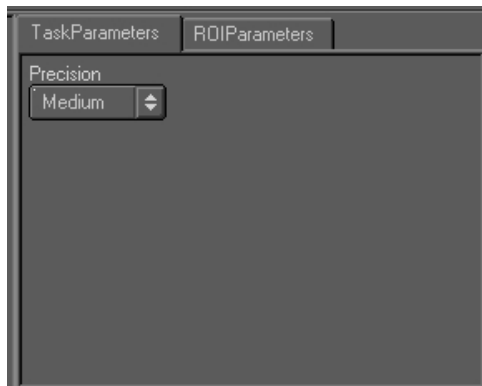
This is the tool for camera motion detection in Diamant.

The process is fully automatic, the results describe camera motion in terms of horizontal and vertical pan, zoom-factor and rotation-angle. An intrinsic reliability-measurement returns a quality indicator.

Settings

The precision-parameter defines if and to which level a subsampling is used to speed up the analysis-process.

The recommendation is to use the default-value (=medium) for all resolutions up to 2k. For 4k and even larger resolution we recommend to use the weakest setting (=low).



Another option is the support of ROI with the module. You might define one! Rectangle ROI (inclusive or exclusive) to restrict the matching-area to some parts of the image. However the ROI can not be selected in Batch processing, it works only when using GlobalMotion from the RestorationManager.

Usage

We recommend to use the tool in batch processing for off-line rendering as the tool is quite time-consuming. However you can also use it when there is need for it, directly from the

RestorationManager. This is wise for difficult scenes, where you want to restrict the detection of camera motion to specific image parts (e.g.: background only around image borders, camera-cache you want to mark-out,...).

Like any analysis module you need to run it only once. Meaning if you use it from the RestorationManager you can delete it after the first round of calculation.

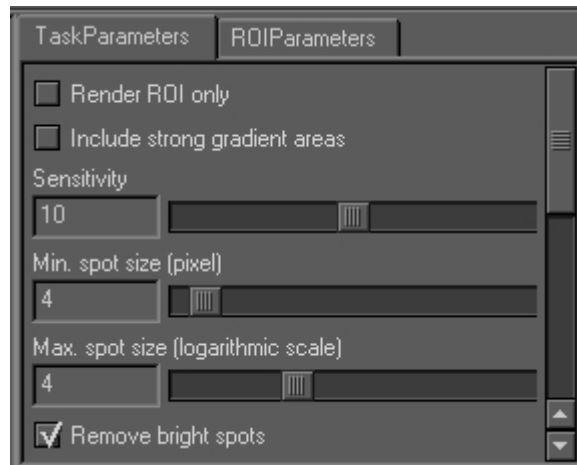
4.2 Restoration Tools

4.2.1 Dust

Tool for detection and correction of spots, stains, hairs, etc. Dust is good for any kind of film defect with a unique appearance in time (=single image defects).

The dust module uses a 2 step approach. In the detection phase the tool looks for spots that are unique in one image (temporal view). Places with spots and dust on it are marked on every frame in a pixel mask. In the removal phase image information is retrieved from the motion-compensated adjacent images and fit into the image to be repaired. The repair also respects brightness variances of the individual images, such that the pasted spot is invisible to a very large extend.

Settings



Render ROI only

Images without any explicitly marked region (ROI) are normally considered to be fully selected; however using this parameter they can be inverted, such that images without explicit ROI are not touched by the tool.

This is useful when working in a more manual mode and using aggressive settings.

In such cases the operator would step through the sequence and explicitly mark regions with spots to be eliminated.

Include strong gradient areas

During normal operation, edges and regular patterns within an image are excluded from the dust detection to protect them against side effects. Activation of this checkbox allows detection of dust on such regions and makes the tool more aggressive.

Sensitivity

This parameter defines the contrast difference between a detected spot and its surroundings (the higher the value the more spots are detected!).

Typical settings for automatic processing are between 0 and 10; for more aggressive or manual operation of “dust” a setting between 16 and 20 should be used.

Min. spot size (in pixel)

This parameter defines the minimum size of dust spots in pixels that can be detected. Usually it should have a value larger than the grain (if there is any) to protect it from mal-detection.

The higher the resolution you are working with, the higher this value should be. Whereas a value of 2 might already be good for tv-resolution, you should not go below 5 for HD and below 10 for 4k. Try rather to further increase this value.

Max. spot size (logarithmic scale)

This parameter determines the maximum size of dust spots to be detected. Typical settings for automatic processing are between 1 and 4 whereas for manual dust-definition the maximum setting of 10 could be used.

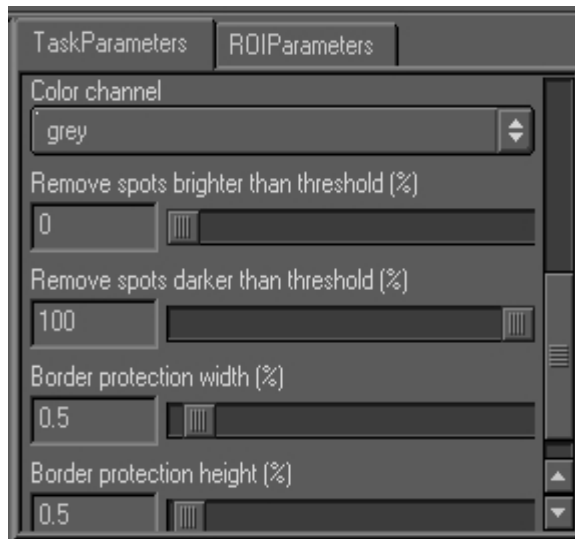
For convenient adjustment, the slider operates on a logarithmic scale:

Maximum spot size setting	Maximum detected spot size [% of image width]
1	0.005
2	0.01
3	0.02
4	0.055
5	0.1
6	0.2
7	0.5
8	1.0
9	10.0
10	40.0

E.g., with this slider set to “8”, all spots bigger than 1% of the image width (i.e., 20 pixels on a 2K image, 7 pixels on a SD image) will be ignored.

Remove bright spots /dark spots

By checking this option, the user can select whether the dust module shall detect and remove bright spots and/or dark spots.



Color channel

This option selects the color channel used for dust detection. It can be set to the luminance channel (“grey”) or one specific chroma channel (“red”, “green”, “blue”).

Remove Spots brighter/darker than Threshold (%)

The threshold slider allows to set an absolute brightness value. Only spots that are brighter/darker than the selected threshold will be removed. If the threshold slider is set to “0” for bright and “100” for dark spots, all detected dark spots (regardless of the absolute brightness value) will be removed.

Border protection width / height (%)

In some cases (overscanned material with moving borders), the dust module can produce side effects on the border of the frames, especially when used with more aggressive settings. The two sliders set the area of the image that will be excluded in % of the total image width/height and thus protect the border from the dust module.

Usage

Practical experience has shown that in case of heavy dust or dirt spots, best results can be achieved with a two-step approach:

1. In the first (full-automatic) step, dust is applied on the whole image with rather defensive parameter settings. This will remove all small dust particles, leaving only a few big spots for the second step.
2. In the second step, dust is applied with different settings. This time, the parameters are set to very aggressive values and the “Render ROI only” option is checked. Now, all remaining dust and dirt spots are isolated by drawing ROIs around them. The tool will only process the explicitly marked areas, thus removing the defects without producing any side effects.

Sample Parameters

The following tables show two basic parameter sets for full automatic and semi automatic (with ROIs) dust removal. These parameters are a good point to start from, but should be optimised for each movie.

Sample parameters for full automatic operation:

Render ROI frames only	OFF (unchecked)
Include strong gradient areas	OFF (unchecked)
Sensitivity	10
Minimal spot size (in pixel)	2 (for SD) or 8 (for HD and 2K)
Maximal spot size (logarithmic scale)	2 or 3
Remove bright spots	ON (checked)
Remove dark spots	ON (checked)
Channel used for detection	grey
Spots brighter than threshold	20%
Spots darker than threshold	80%
Preserve border (% of image width)	0,3%

Sample parameters for semi automatic operation: (use with ROIs only!)

Render ROI frames only	ON (checked)
Activate dust detection on strong gradients	ON (checked)
Sensitivity	18 or 20 (depending on grain)
Minimal spot size (in pixel)	2 (for SD) or 5 (for HD and 2K)

Maximal spot size (logarithmic scale)	10
Remove bright spots	ON (checked)
Remove dark spots	ON (checked)
Channel used for detection	grey
Spots brighter than threshold	0%
Spots darker than threshold	100%
Preserve border (% of image width)	0%

Optimisation of parameters

After setting first guess parameters for the full automatic step, render a few typical images. Depending on the results, the parameters can be optimised:

- grey dust spots not removed: increase Sensitivity
- big dust spots not removed: check maximum size setting
- small dust spots not removed: check minimum size setting, activate “Include very fine dust” option
- bright spots not removed: check brightness threshold
- dark spots not removed: check brightness threshold
- spots on gradients not removed: activate “include strong gradient areas”
- spots near frame borders not removed: set “border protection” to 0

Unless you are an experienced operator, it is advisable to change only one parameter at a time. After making your changes, re-render the test frames and watch for side effects. If too many side effects occur, set the parameters back to the previous values and remove the remaining defects in the second (semi-automatic) step.

When you are happy with the identified settings for your few typical images, you should assign a setting-name and store it for application on sequence and all sequences of your movie.

4.2.2 DNoise

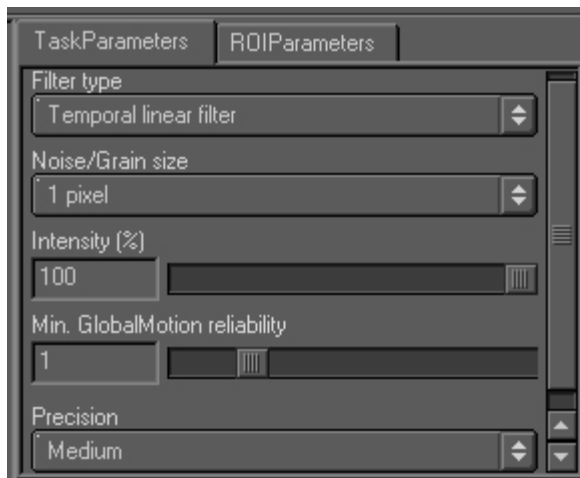
DNoise is the main tool for de-noise and/or grain-reduction. It preserves edges and gradients to a very large extend.

The tool is performing an intelligent filtering (e.g.: motion compensated temporal filter) over adjacent images for each pixel or group of pixels. As motion compensation is very critical for a high quality noise reduction, the background objects of the images are compensated with calculated camera-motion (see GlobalMotion tool), whereas the (moving) foreground objects are compensated with pixel-motion (see LocalMotion or PixelMotion tools).

Settings

Filter type

The operator can select the type of filter used in the interpolation process. Choosing the “linear filter” setting invokes a standard mathematical averaging algorithm over the temporal domain, whereas the “median filter” applies the well known median. Usually the results are much better with linear filters, therefore in almost every cases linear filtering should be used.



Noise grain size

Describes the typical size of the grain and is used as spatial filter. Increasing this value above 1 pixel might result in loss of details, but a higher suppression is possible.

Intensity (%)

This slider allows to set the amount of noise reduction. At the leftmost position (0%), the image is not changed. At the rightmost position (100%), the maximum possible noise reduction is performed.

Min. GlobalMotion reliability

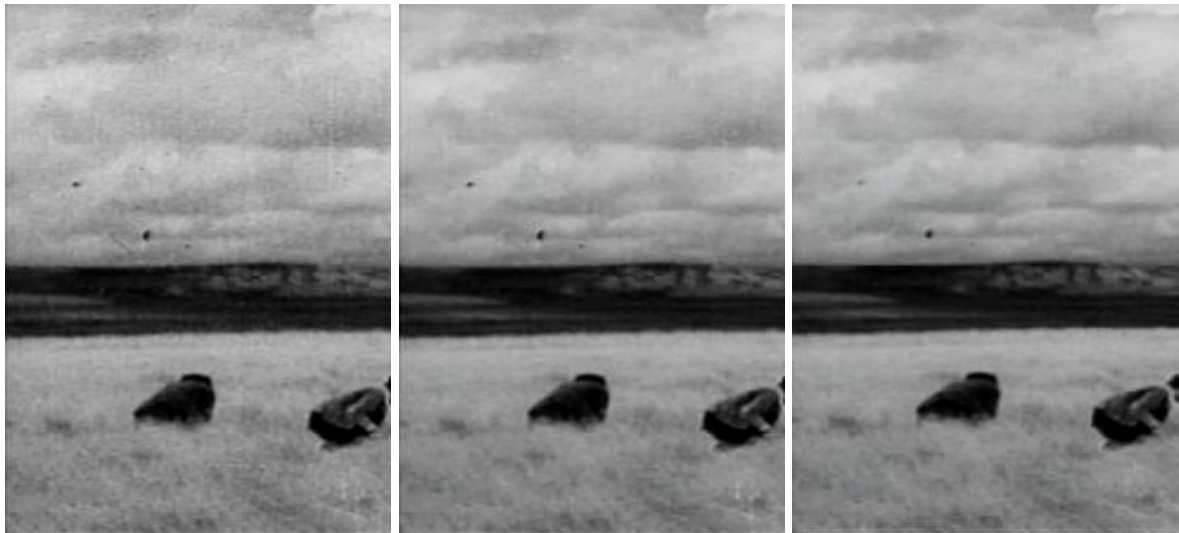
If GlobalMotion did not find reliable motion (e.g., scenes with large water surfaces, etc.) false operation can be minimised by this parameter. Higher values result in less correction but also less side-effects.

Precision

This parameter sets the mathematical precision used in the tool. Especially on high resolution material (e.g.: 4k) you could use a value of “low”, shortening the calculation time considerably.

Usage

On the basis of a single image you can find the best parameter setting. If you are happy with the details after DNoise you should apply it on the sequence. Check the results carefully – too aggressive settings could result in loss of detail.

*Original**Grain size = 1 pixel**Grain size = 3 pixel*

You can also use the Sharpen tool in combination with DNoise in order to avoid any “softness effects”.

The DNoise tool can also be used to reduce colour stain effects from old color material.

4.2.3 RGrain

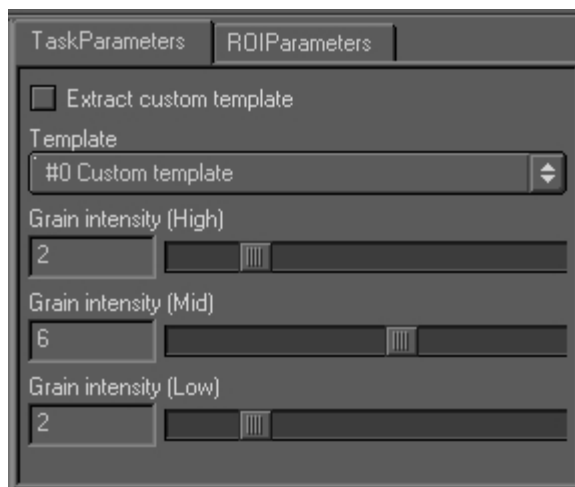
Restoration of heavily affected film might result in a dramatic loss of original film grain. On the other hand, film reconstruction is often confronted with a material-mix from different film sources (different film generations, positives, Dups, Negatives,...). This tool is to compensate for those undesirable effects.

Settings

Extract custom template

If this parameter is selected, you do not add any grain to your sequence, but you use the selected image to extract the grain and generate a custom template, that can be used for RGrain on other sequences or at least other position in the current sequence.

If you deselect this parameter than it has no further effect on the tool.



Template

Offers a choice of predefined grain templates and the custom template for selection. If you want to use the custom template you need to have run the tool with selected "Extract custom template" before. If you haven't done so the tool will end with an error-message.

Grain intensity (High/Mid/Low)

The characteristics of the added grain can be influenced beyond the extracted pattern to match it to an existing film. Change these values only if you are an experienced user.

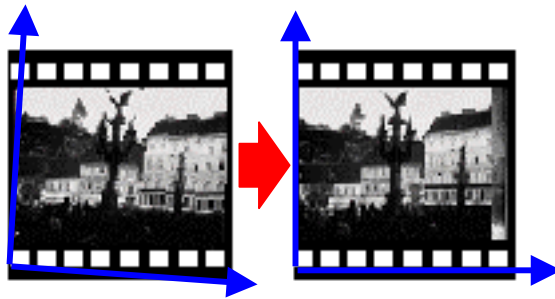
Usage

First, you have to identify one image from your footage that contains your desired type of grain. Navigate to such image in the RestorationManager and put the RGrain tool in the task list. By selecting the option "Extract custom template" and applying a "Render 1 Frame" a user defined custom template is generated, describing the characteristics of your grain.

Consequently you have to switch to the sequence where you want to apply the RGrain. There you select the tool with your setting. Try the default-setting if you want to work with your previously generated custom template or select any predefined grain template.

4.2.4 StabAuto

The StabAuto tool is designed for automatic correction of image stability problems, i.e. vertical, horizontal or rotation movements or scaling of the complete image from one frame to another. It respects natural camera movement and determines automatically the background that should be stabilised.



Example: correction of an image rotation error

StabAuto uses the motion information generated by the GlobalMotion tool. By analysing the motion vectors, the tool can distinguish between normal image motion (e.g., camera pan or zoom) and unwanted motion (jitter). The jitter is removed by filtering the motion information and eliminating the high frequencies. The amount of filtering can be selected by the operator. After this, the images are transformed (shifted, rotated, etc.) to match the new (filtered) motion vectors.

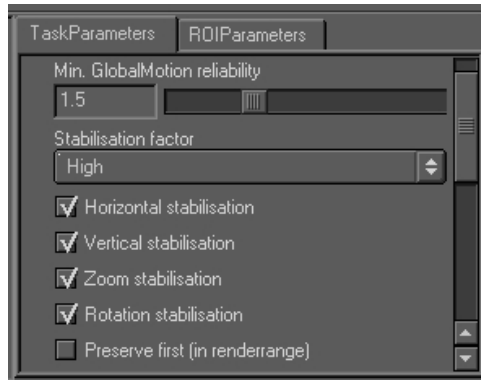
Settings

Min. GlobalMotion reliability

In some scenes the GlobalMotion tool cannot provide reliable motion information (e.g., scenes with large water surfaces, etc.). This parameter prevents false operation in such cases. When the motion reliability falls below the value, the tool does not use this information for correction.

Stabilisation factor

Defines how strong the stabilisation process will be applied and offers 3 predefined values. Depending on the content and the restoration purpose you might want to apply different strong settings and get more or less fixed cameras.

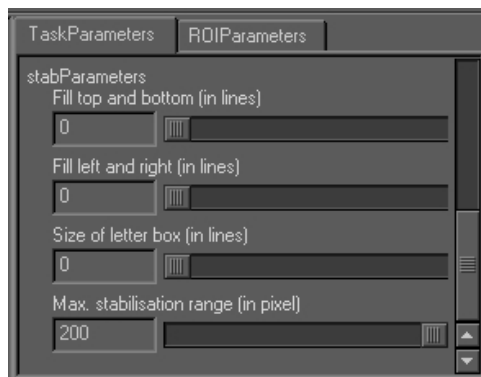


Horizontal / Vertical / Zoom / Rotation stabilisation

Correction takes place in 4 different dimensions: vertical (x), horizontal (y), zoom and rotation. Each of these possible movements can be en- or disabled. As the correction of zoom and rotation occasionally creates unwanted side effects, you might for some purposes want to stabilise the pan-jitter only. Select the appropriate checkboxes depending on your requirements.

Preserve first / last image

When stabilising only parts of a scene, it is necessary to fix the position of the first and last images in order to match to the untouched parts of the sequence. With one or both checkboxes activated, the first and/or last image within the render-range of the sequence will be left in the original position.



Preserve cut

Very often the images around a cut are showing strong instability effects. Thus StabAuto does usually correct such images, however in some cases you might want to fix the images around a cut. Enabling this option does exactly this.

Fill top and bottom / Fill left and right

During stabilisation, the module shifts each image in some direction, thereby creating areas where image

data is missing. The “Fill” sliders are used to control the way the module fills these missing areas.

With the “Fill” sliders set to 0, this data is copied from the adjacent lines/columns. By moving the sliders up (e.g., to “5”), the module is instructed not to use the data from the outmost pixels, but from 5 pixels inward of the image boundary.

Size of letter box

In addition to the automatic filling of missing image areas, a letter box mask can be applied to mask out the top and bottom areas of the image, thereby concealing the image shift. Use the “Size of Letterbox” slider to set the height of area to be masked out.

Max. stabilisation range

This is the maximum number of pixels the stab module may shift one image to a certain direction.

Usage

As stabilisation changes the image positions individually, any precalculated motion information becomes invalid. However in DIAMANT this decision is left to the operator, thus you should be aware that you need to recalculate LocalMotion /PixelMotion and GlobalMotion if you continue with the restoration process after stabilisation.

For an efficient stabilisation we recommend to do either StabAuto or DShake on the whole sequence. Then, in the quality verification phase the operator should determine those scenes, where the stabilisation did not bring satisfying results. Such scenes should be recalculated by another stabilisation tool. This approach proved to be much more efficient than the variation of individual module parameters.

However in some cases you might want to calculate the GlobalMotion just before the StabAuto. If you do so, you could define a rectangle- ROI inside GlobalMotion to mark only those parts of the image that you feel should be the basis for stabilisation (usually this is the background!). This might be a helpful approach if you have some strong moving objects in the foreground, misleading the GlobalMotion if the objects are not masked out by a (red colored) rectangle-ROI (see also the chapter about GlobalMotion).

4.2.5 DShake

DShake offers a fast and convenient approach for automatic stabilisation inside DIAMANT. DShake is significantly faster than StabAuto as it does not require GlobalMotion to be calculated before. It is a real alternative for StabAuto, especially on all resolutions up to HD. DShake does also work on interlaced video material.

DShake internally works in 2 passes, the first is a motion estimation based on an integrated block matching algorithm, that is followed by the correction phase.

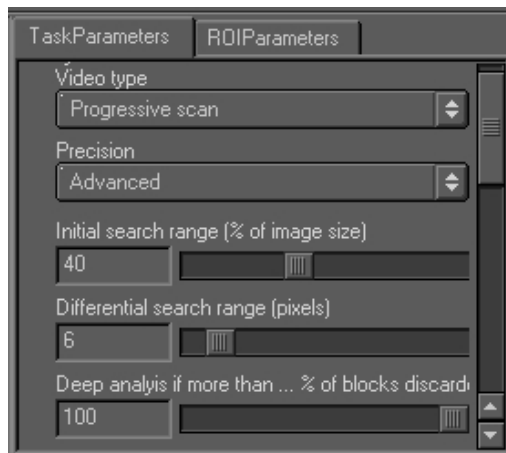
Settings

Video Type

By selection you can indicate if your sequence is progressive or interlaced. This information influences the stabilisation process significantly as only this option guarantees that the resulting sequence is also interlaced in the same way!

Precision

DShake can analyse the film in smaller resolution to speed up the restoration process. For SD and HD we recommend to use the best level (i.e.: “Advanced”) whereas for 2k or more “Medium” should be good enough. The value “Low” should only be used if calculation time is the most critical factor (e.g.: 4k).



Initial search range

This is one important parameter for the block-matching algorithm that is used to detect camera movement. Increase the value only if DShake fails on certain scenes due to high camera movement, as increasing seriously affects calculation time.

Differential search range

This is another important parameter for the block-matching algorithm that is used to detect camera movement. Increasing the parameter makes motion estimation significantly more reliable, but is highly compute intensive. Thus you should only use

higher values if you encounter difficulties with certain scenes.

Deep analysis

If a certain amount of motion-blocks is discarded, you could force a deep analysis. Lowering this value will improve results but also increase calculation time.

Preserve first / last

When stabilising only parts of a scene, it is necessary to fix the position of the first and last frames in order to match the remaining parts of the sequence. With one or both checkboxes activated, the first and/or last frame of the sequence will be left in the original position.

Preserve cut

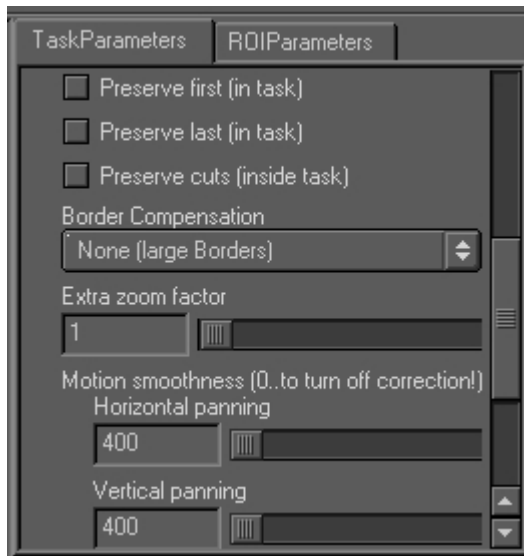
Very often the images around a cut are showing strong instability effects. Thus StabAuto does usually correct such images, however in some cases you might want to fix the images around a cut. Enabling this option does exactly this.

Border compensation

Stabilisation always affects the image border of the shifted images. No compensation means that the corrected images might get a black border around them. The DIAMANT-tool “zoom” has been made to handle such issues at a later stage, but you can directly apply some remedy for that herein.

“Adaptive zoom” adds an additional zoom in order to minimise the black borders resulting from the stabilisation. However such a feature has to be applied carefully, as it is usually not acceptable for preservation purposes. On the other hand it provides a quick solution for restoration jobs, where cost & time pressure is the driving factor.

“Fixed zoom” automatically determines the minimal zoom level that is needed to get rid of unwanted black borders. Dynamic changes in zoom are avoided. See the next parameter *“Extra zoom factor”* for a manual setting of the zoom level.



Extra zoom factor

If the automated border compensation of DShake is not wanted or if an extra zoom is desired, the operator can give a fixed zoom factor manually, that is applied on every single image.

Motion smoothness

This factor is available separately for all dimensions of the correction. A value of "0" turns the correction completely off, whereas increasing values results in an increase of potential shifts for every image. High values make the movement after stabilisation look like very smooth. The maximum value creates almost a freeze frame on slowly changing camera.

Usage

The module has been made for resolutions up to HD. Although the tool works with 2k and even 4k, there might be some fine-tuning of parameters necessary.

When restoring movies you might find that some sequences are very hard to restore by DShake. The usual way to handle also such sequences is to try on the unsatisfying jobs a combination of GlobalMotion, StabAuto and the manual stabilisation tools, depending on your requirements.

However DShake works quite efficient and should be good for some 90% of the shots.

There are some more parameters of DShake that are not available as user parameters. Thus our support can help you when encountering severe problems with a certain movie.

4.2.6 StabPoint

The tool provides image stabilisation based on point tracking. It is used to correct image jitter in cases where the automatic stabilisation tools (StabAuto, DShake) do not give proper results.

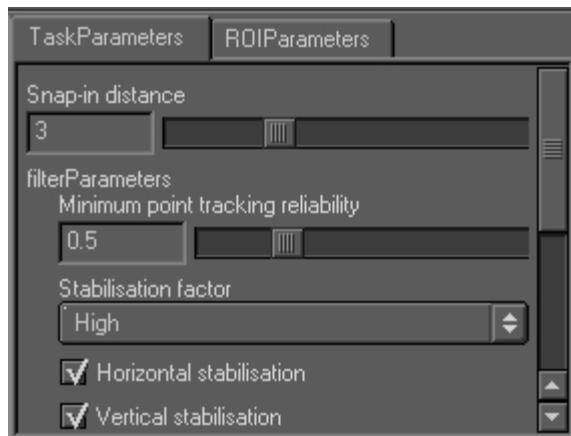
The tool works with a three step algorithm:

- In the first step, prominent points in the picture are manually marked on a key frame (freely selectable by the operator; one key frame per shot). These points are then tracked throughout the shot to obtain the image motion information.
- In the second step, this motion information is filtered to remove fast motion like jitter, but preserve slow motion like camera pans. The parameters for the filter can be set by the operator.
- In the third step, each image is shifted to match the new (filtered) motion.

Settings

Snap-in distance

Before tracking, the point tracker looks around the manually marked points, trying to find the best contrast to lock to. This parameter represents the size of the area to be analysed. Setting the slider to 0 disables the snap-in function.



Minimal point tracking reliability

This slider sets a threshold value for the stabilisation. If the point tracking data becomes unreliable on one frame, that individual frame will be left in its original position. Increase this threshold if the overall stabilisation result is good except on a few frames within the sequence.

Stabilisation factor

Defines how strong the stabilisation process will be applied and offers 3 predefined values.

Depending on the content and the restoration purpose you might want to apply different strong settings and get more or less fixed cameras.

Horizontal / Vertical / Zoom / Rotation filtering

Correction takes place in 4 different dimensions: vertical (x), horizontal (y), zoom and rotation. Each of these possible movements can be en- or disabled. As the correction of zoom and rotation occasionally creates unwanted side effects, you might for some purposes want to stabilise the pan-jitter only. Select the appropriate checkboxes depending on your requirements.

Preserve border position

Sometimes, only a few image ranges within one shot needs to be stabilised. In this case it is important to preserve the original positions of the first and last images (=border position). This can be done by activating this parameter.

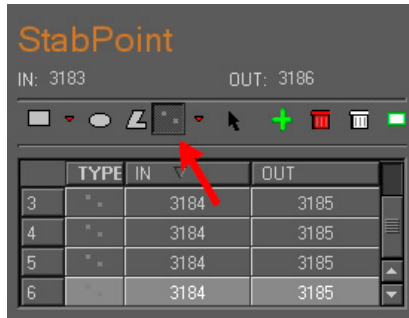
Track points / Filter / Stabilise

These checkboxes activate the individual phases of the stabilisation procedure. Usually all 3 phases are processed in one step, but if you want to get some feedback about the tracked points you can also run the phases individually. When doing so, the operator must pay attention to the correct order of the phases (e.g.: the last phase requires that the previous ones have already been calculated – you can not drop one phase!

Usage

First, select points to track:

- One image is selected to set the reference points for tracking. Position the Restoration Manager on this frame and use the ROI editor's "point" tool to set the reference points.



RIO editor point tool



the reference points are marked purple

- Points must be placed on the objects with the least movement in the sequence (i.e.: on the background)
- The points should be carefully balanced on the image area (do not put them all in one edge!)
- The points should have sufficient contrast

Second, check the point tracking:

- Activate "Tracking" checkbox, deactivate "Filter" and "Stabilize" checkboxes
- Render the shot
- Step through the sequence and watch the tracking points. There must be at least 2 green (locked) points at every frame. Red markers indicate that the point has been lost (e.g. due to insufficient contrast), green markers show that the point has been tracked successfully.



Third, select filtering parameters:

- Try the standard setting first.
- For sequences with slow camera motion, increase the setting to "Low" or "High".

Fourth, render the stabilization:

- Select “Filter” and “Stabilize” mode.
- Render the Shot

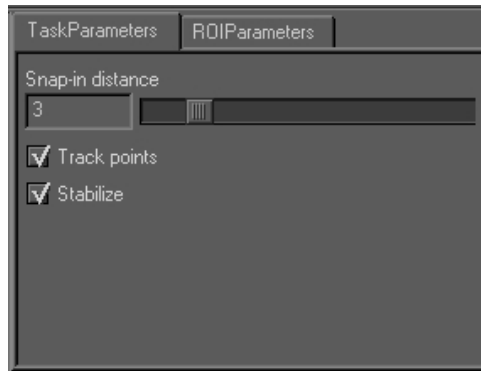
Be aware that you can run steps 2,3 and 4 in once. This is the usual and efficient way of operation!

4.2.7 StabPointLock

The tools work very similar to StabPoint, but it locks the background. Thus it can only be used for shots with fixed camera. As old silent movies have very often been shot with fixed camera you might find this tool very usefull. As the tool has been developped with archival co-operation, it does hardly introduce unnatural steadiness, but respects the nature of old film.

The tool follows a 2 phase approach. It first tracks the manually marked points and does the correction in a separate pass.

Settings



Snap-in distance

Before tracking, the point tracker looks around the manually marked points, trying to find the best contrast to lock to. This parameter represents the size of the area to be analysed. Setting the slider to 0 disables the snap-in function.

Track points / Stabilise

These checkboxes activate the individual phases of the stabilisation procedure. Usually all 2 phases are processed in one step, but if you want to get some feedback about the tracked points you can also run the phases individually. When doing so, the operator must pay attention to the correct order of the phases (e.g.: the last phase requires that the previous ones have already been calculated – you can not drop one phase!

Usage

The interaction with the tool is very similar to the one with the StabPoint. Basically the operator needs to select one reference image, then mark manual points in the image and then process the sequence.

Manual point selection should follow the following rules:

- Points must be placed on the objects with the least movement in the sequence (on the background)
- The points should be carefully balanced on the image area (do not put them all in one edge!)
- The points should have sufficient contrast

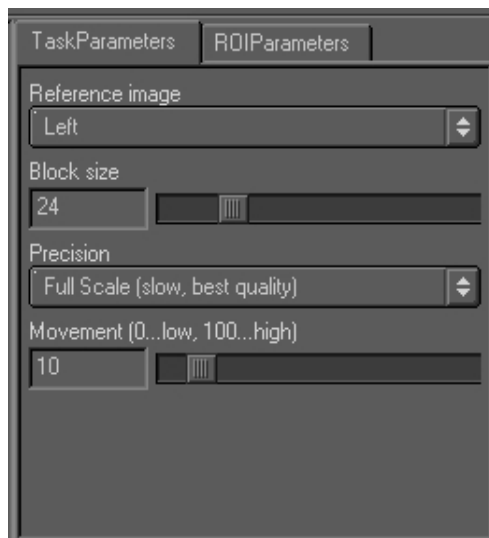
4.2.8 DWarp

Warped and inhomogenous stressed images are very often a consequence of shrunken nitrate, improper splices or non-perfect scanning. Very often such effects become annoying after elimination of other disturbing defects (e.g.: camera movement). The uses the image information of the stressed and warped images and does not drop any original content. The correction is based on a reference image, that is used as basis for detection of the DWarp-Function. It is recommended to use a neighbouring image as reference, although you can principally apply the DWarp tool on several consecutive images in time.

Settings

Reference image

The Reference image is similar than the one used for DFlicker (you can define them by “r” in RestorationManager). However Reference in this case means the closest image that is not warped and is in good shape. There should not be much motion from the Reference image to the one you want to DWarp, as the tool can hardly distinguish between motion and warping effects.



Block size

As DWarp is based on a matching procedure between Reference and image to be corrected, the Block size influences the matching quality. This parameter should only be changed if you experience problems.

Precision

Defines if subsampling is used or not. For resolutions up to 2k you should use the best available choice.

Movement

Characteristics of the movement in the scene. Increase if you have fast moving objects or a big difference to the Reference image.

Usage

As the tool uses Reference images in a similar way than DFlicker, you have to make sure not to use DFlicker and DWarp at the same time (= same generation and same parts in the RestorationManager). Make sure that you verify all Reference images before applying the tool. To be sure you can delete all previously defined Reference images, before starting a DIAMANT generation with DWarp inside.

Although you can apply the tool on longer sequences, provided that you have sufficient Reference images defined, it is to state that the tool is usually applied on single images only. This is the reason why the default-duration of the tool is one single image!

In some cases when the tool might not work properly, we recommend to use Interpolate_frame as bypass. However we invite you to send us a note and the sample image, so we can further improve this new tool.

4.2.9 Linescratch

Vertical lines are one of the most embarrassing defects in old, historical films. Repair of such scratches is a very difficult task, as there is real information missing for the full temporal duration of the linescratch. Thus content reconstruction is the key to a high quality restoration.

The Linescratch tool is a powerful and highly automated scratch removal tool available as an option in DIAMANT.

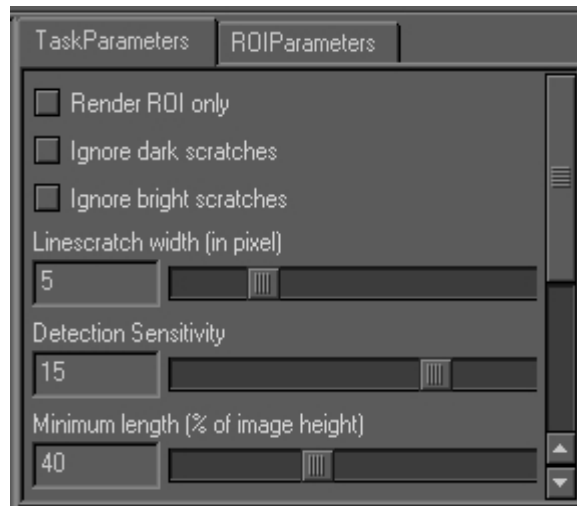
Settings

Render ROI only

Images without any explicitly marked region (ROI) are normally considered to be fully selected; however using this parameter they can be inverted, such that images without explicit ROI are not touched by the tool.

This is useful when working in a more manual mode and using aggressive settings.

In such cases the operator would step through the sequence and explicitly mark linescratches to be eliminated.



Ignore dark / light scratches

By activating these checkboxes, the operator can prevent the detection of dark or bright scratches

Linescratch width

Sets the width of scratches to be detected, usually an estimate in the order of the width is sufficient.

Detection sensitivity

This parameter selects the sensitivity for scratch detection. A higher value will result in more detected scratches.

Minimum length

This parameter limits the minimum length of scratches to be detected. Any scratches shorter than this value will be ignored.

Enlarge after detection

With some scratch types, it can be necessary to interpolate a few pixels more than detected. This slider allows to set a number of pixels that will be added to the detected width of the scratch before interpolating.

Color channel used in linescratch detection

With this option the operator can set the detection to use one specific color channel only. For detection on all channels, set this option to “grey”.

Contrast enhancement

To aid the detection of low contrast scratches, a contrast enhancement algorithm is usually applied to the input image before passing it on to the detection mechanism.

Usage

Linescratch has to be much more carefully used than other restoration tools. In general we recommend to use Linescratch in combination with ROI. If you use Linescratch with high Sensitivity value and not restricted to ROI you risk to create many side effects.

The recommended approach is to look for an image with a typical visibility of the linescratches you want to correct. Then take the tool and try various settings (starting from the default) to find the best matching values. Then we recommend to mark the linescratch with a ROI (make the ROI big enough, so it will also contain the linescratch on other images). Then verify the ROI in time, so that start and end-image are fitting well.

After render it might happen that the linescratch or some relicts are still visible on single images. If you run Dust and eventually DNoise after! Linescratch, those tools could process the remnants and make the result look perfect. Ideally you also do a LocalMotion or PixelMotion before such a Dust, but after Linescratch!

If your corrected scratch looks either too dark or too bright, than you should increase the parameter “Enlarge after detection”. Try a setting of 2 first.

Be also aware that linescratch works much better if you look either for bright or for dark scratches. Looking for both at the same time, does not bring compareable good results! If you have to deal with bright and dark scratches in one sequence we rather recommend to use 2 linescratch tools – one with a setting for bright and the second with a setting for dark.

4.2.10 InterpolateImage / InterpolateSequence

The interpolate tools are used to replace one or more images or parts of images where no image information is left (e.g., burned-up frames, huge tears etc.). The selected area is replaced with information generated from the adjacent images by motion compensated interpolation.

The tools make a match of the neighbouring images and determine the motion vectors. Based on that the area is calculated. The content fits into the detected motion and is then used to replace the damaged areas.

Both tools are described in this section as they are almost identical. The tools are just differently preconfigured and you could simply turn the configuration from one into the other.

Settings

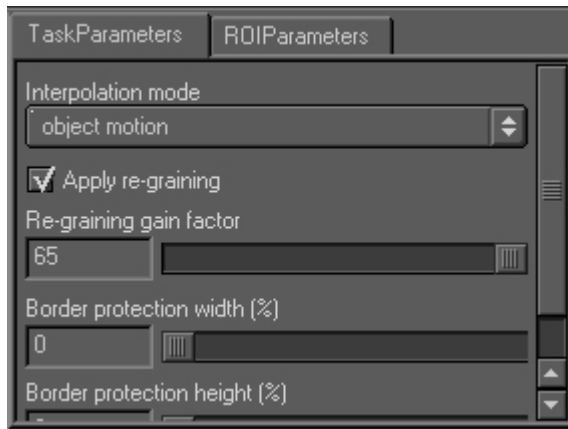
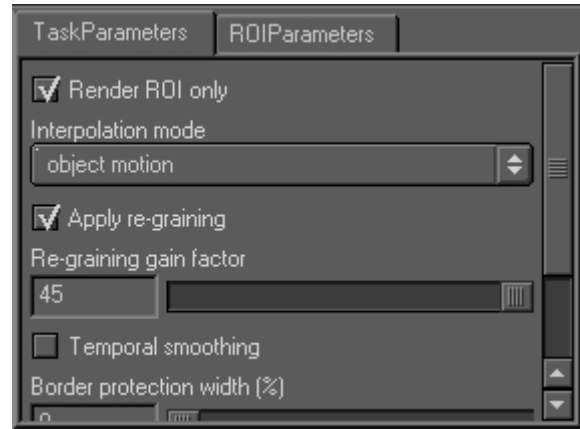
Render ROI only *[only in InterpolateSequence]*

If this option is selected, the tool will affect only images that have a ROI selection. If there is such a ROI the tool looks for the image before the start of ROI and the image immediately after the ROI. Both images are taken then as basis for the correction.

Interpolation Mode

The module calculates two types of motion information. Object motion describes the image activity on pixel-by-pixel-scale, while the camera motion gives a general description of the dominant motion within the image.

Typically, using the local motion for interpolation yields the best results. However, if the processed image sequence contains no object movement but only camera movement (e.g.: landscape scenery with only camera pan or zoom) the alternative setting would return better (more stable) results, especially if you interpolate more than one image.

*InterpolateImage**InterpolateSequence*

Apply re-graining / Re-graining gain

Due to the nature of interpolate the result is automatically reduced in noise. This might affect the film grain. In order to compensate for that, we have introduced a re-grain function. The Gain parameter defines how much of the grain you want to put back on the interpolated parts. Lower values result in less grain.

Temporal Smoothing *[only in InterpolateSequence]*

This option changes the way the input frames are selected. When enabled, each interpolation uses the frame before the current frame as an input (as opposed to the standard operation, there the frame at the beginning of the interpolation job is used). This option makes only sense on extremely affected distortions and creates a completely artificial scene. So do not use this option for preservation purposes!

Border protection width / height (%)

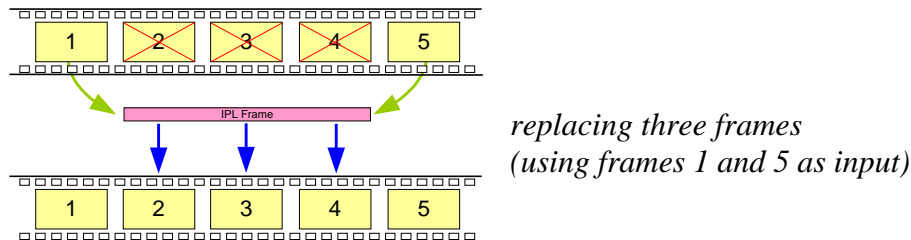
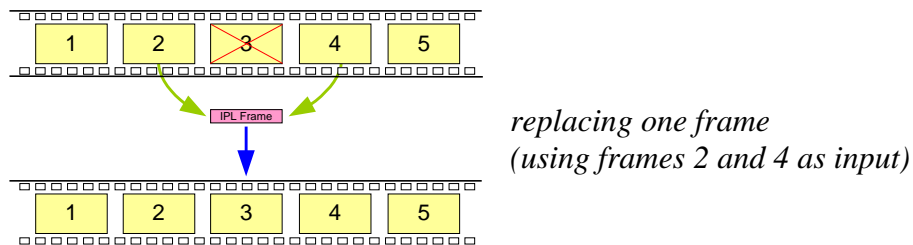
Interpolation on the border of the image is difficult, thus you can protect the border to avoid unwanted side-effects. The two sliders set the area of the image that will be excluded in % of the total image width/height and thus protect the border from the dust module.

Usage

The number of frames to be replaced is determined by the length of the tool in the RestorationManager resp. by the length of the marked ROI. By default, the tool is either one image (InterpolateImage) or the full sequence (InterpolateSequence).

To replace more than one image with InterpolateImage, the length of the module must be adjusted.

The images used for interpolation are always the one before the tool/ROI's in-point and the one after the tool/ROI's out-point.

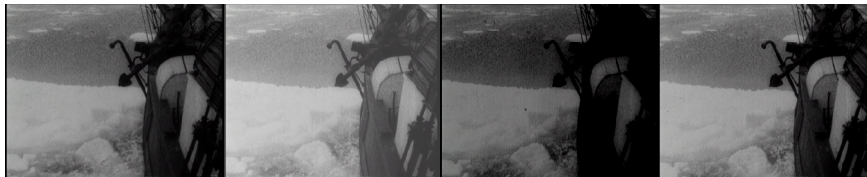


4.2.11 Dflicker

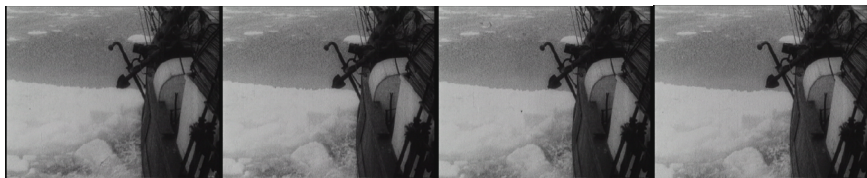
Flickering are global brightness, contrast and/or colour changes from one image to the next. DFlicker is able to correct both brightness and colour flicker on a global as well as on a local basis.

Each frame in the sequence is compared to one Reference image and a correction function is computed for each channel (RGB or HSV). Then, each pixel is corrected using the computed function.

Compensation for moving objects is of special value in case of local flicker correction.



flickering sequence



corrected sequence

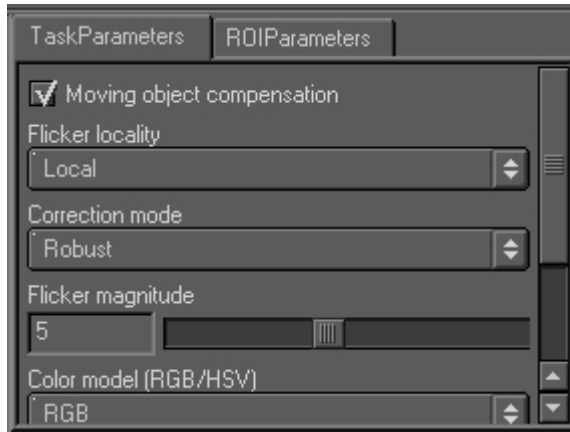
Settings

Moving object compensation

If checkbox is used the motion to reference images is calculated and respected prior to correction. This makes the tool significantly more robust and the parameter should be heavily used in combination with local flicker. However processing time increases significantly if this option is used!

Flicker locality

Flicker can be global, local or local advanced. A good value is local in combination with selected “Moving object compensation”; another good value is global without “Moving object compensation”.



Correction Mode

Depending on the type of flicker problem, the flicker 2 module can work in two processing modes. In “Advanced” mode, the correction is more precise, but at the same time more vulnerable to errors due to moving objects or other influences. In these cases, the module should be switched to “Robust” mode, which uses more robust detection settings.

Flicker magnitude

This slider gives an indication about the intensity of the flicker variations. A good starting value is 5, increase it for extreme flicker defects.

Color Model

The module can work in HSV or RGB colour models. Depending on the type of flicker, selecting a different colour model can improve the deflickering result.

HSV/RGB Checkboxes

Each Correction channel can be switched on and off individually. Thereby, the operator can prevent unwanted changes and increase the processing speed.

Usage

Since the Reference images are the main source of information for the DFlicker tool, it is crucial to select the right frames in this step. Bad Reference selection may result in no apparant flicker reduction or even increase the flickering in some situations.

This process can be done in several ways (see also the tool Reference):

Automatic Selection

Use on the Reference tool (either in Batchprocessing or run it from RestoratioManager). It is recommended to revise the selected reference frames after the automatic selection process (simply use the <SHIFT>< ⬅ > and <SHIFT>< ➡ > keys to make verifications in the RestorationManager and use “r” to toggle between reference-frame selection and de-selection.

Manual Selection

In the RestorationManager, step through the sequence and try to find the frames with the best brightness, contrast and colours. Press “r” to mark / unmark frames as references. Use <SHIFT>< ⬅ > and <SHIFT>< ➡ > to jump back and forth between the selected frames and check if they are equal in brightness, contrast etc.

4.2.12 Sharpen

The tool is capable to de-blur images within a sequence. The operator can select the amount of edge enhancement. It is often used together with the DNoise module.

Settings

Magnitude of sharpening

This slider controls the amount of edge enhancement applied to each frame. The higher the number, the stronger the effect.

Usage



original image



moderate



strong

Be aware of the fact that strong sharpening will also amplify background noise.

4.2.13 Zoom

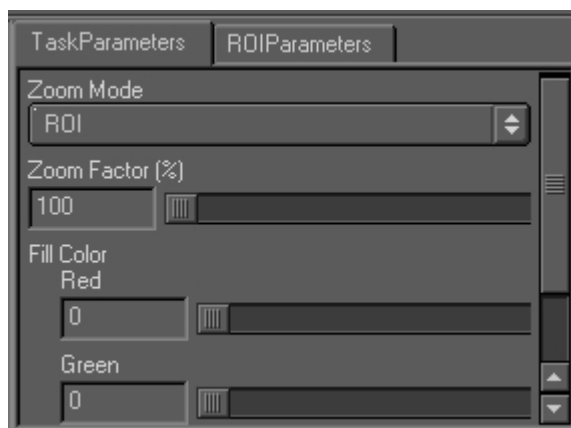
The Zoom tool can be used to either zoom into the image, or create a defined border around the image. The most common application in DIAMANT is to fix the image borders in the finishing pass (e.g.: after stabilisation).

Settings

Zoom Mode

The value of this major parameter defines the operation of the tool.

- **Fill Color**
Fills the border outside of a marked ROI with the color values defined in the Fill Color parameter. There is no action if there is no ROI in the image.
- **Factor**
The image is resized (zoomed into it, from the center) according to the value given in the Factor parameter. There is no need to define a ROI for this selection, but if you have one, only the area inside the ROI is scaled up.
- **ROI / ROI – preserve aspect**
Ignores all other parameters, takes the green marked rectangle ROI and enlarges it to the full size.



Factor

Describes the zoom factor in percentag, where 100% is no zoom and 200% is double size.

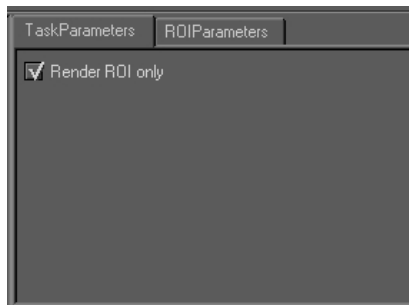
Fill Color

Defines the color in RGB values, where 0 is for no light and 254 for maximum light.

4.2.14 Replace

The Replace tool provides a way of removing static image defects that appear at the same position in a number of successive images. In such cases, the dust removal can not be applied. The Replace module uses a local interpolation algorithm that is quite limited. It is not possible to replace big areas.

Settings



Render ROI only

If this option is selected, the tool will affect only images that have a ROI selection.

Usage

Mark any small spots and hairs you want to get fixed carefully with a (polygonal) ROI. If the objects are on more than one consecutive image, you should work with animated ROI's. It is very important to make a careful selection, as the whole content of the selection is discarded and the area is refilled by the tool.

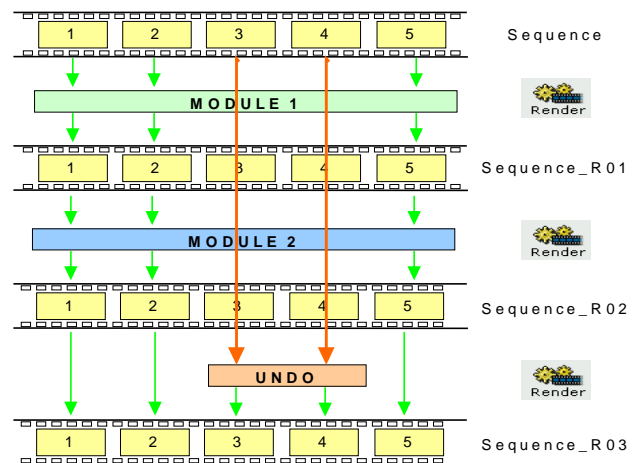
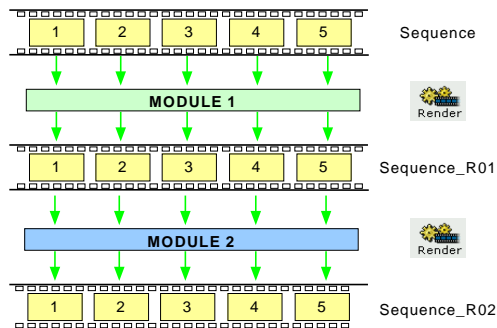
Try on one image first to see if you like the result or not. Non-structured background (e.g.: sky,...) is usually less sensitive, so you can try on larger areas there than on structured objects.

If you can not find a proper setting you need to do a manual retouch in the worst case. Use M.I.R. for that.

4.2.15 Undo

The data management within the DIAMANT system is based on the concept of generations. Each operation is performed “in between” two generations, one providing the input data, and the other one containing the processed images. While this model provides convenient and storage effective data management, it is sometimes necessary to bypass this mechanism.

One typical use case is an artefact that is experienced in the verification phase. The Undo tool permits to undo such an artefact by inserting content from the original or one earlier DIAMANT generation.



Settings

Render ROI only

If this option is selected, the tool will affect only images that have a ROI selection.

Image source

This selector sets the data source from which the areas will be undone. Select “Original” for the originally imported data, or “R01” to “Rxx” for the desired DIAMANT generation.

4.2.16 **FieldSplit**

Interlaced video source can principally not be treated the same way than (progressive) film material. Thus the most DIAMANT tools like dust, noise, StabAuto, StabPoint,... can not be applied on interlaced video sequences.

In order to process such material you either need to deinterlace it first (for permanent deinterlacing use Dinterlace). If you need to preserve the interlaced structure you have to do a temporal field separation and merge it after restoration.

FieldSplit separates the two video frames (even and odd) within one image, so that the resulting sequence can then be treated like film. All DIAMANT tools (despite stabilisation functions) can be applied and in the finishing phase another FieldSplit will merge the fields together.

Settings

Mode

Sets the operation mode of the module. If set to "Split fields", the module splits the image into the two fields. To recombine the fields into one frame after restoration, the "Merge fields" setting has to be used.

Usage

Place all line-critical tools like Dust and DNoise in between 2 FieldSplit tools. Be aware that you need to do also all motion processing (e.g.: GlobalMotion, LocalMotion) after the first FieldSplit.

It is also recommended to protect the border between the 2 separated fields by ROI to avoid any side-effects there.

For simple restoration jobs (e.g.: automatic dust cleaning) you can combine all these actions into one DIAMANT job. But for more difficult restoration you need to work with the generation concept in DIAMANT and do step by step.

For stabilisation of interlaced material you should refer to DShake. You must not use FieldSplit in combination with stabilisation!

4.2.17 DInterlace

The tool offers a way to turn interlaced video sequences permanently into progressive material.

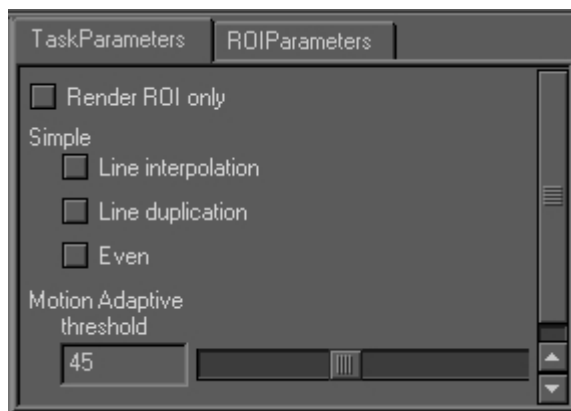
The tool offers 3 different quality levels, for restoration purposes we recommend to use the best quality, that is based on motion estimation and does not drop unnecessary image content.

- **Line Interpolation:** The data from two lines (e.g.: 10 and 12) is used to calculate the pixel values of the line in between (e.g.: 11).
- **Line Duplication:** One line (e.g.: 10) is copied to the next (12).
- **Motion Adaptive:** A motion detector is used to isolate the areas of the image that need to be deinterlaced. In a second step, these areas are scanned for interlacing artefacts. If any interlacing is detected, the area is deinterlaced by means of a motion compensated interpolation process.

Settings

Render ROI only

If this option is selected, the tool will affect only images that have a ROI selection.



Line interpolation / duplication

Selects mode for Dinterlace. If both boxes are deselected than the best quality method is used.

Even

By default, the Line Interpolation and Line Duplication algorithms use the odd field (odd line numbers, 1-3-5-7 etc.) as input data. You can force to use the even fields by selecting this option.

Motion Adaptive

This setting only applies to the Motion Adaptive Algorithm. The slider sets the threshold for the motion detection, which is used to detect the areas of the image in which motion occurs. Only these areas are taken into consideration for the deinterlacing.

4.2.18 DropOut

Dropouts are a very frequent defect with video source material. In general we have to distinguish between “short” (a few missing pixels) and “long” (several missing lines) dropouts.

Settings

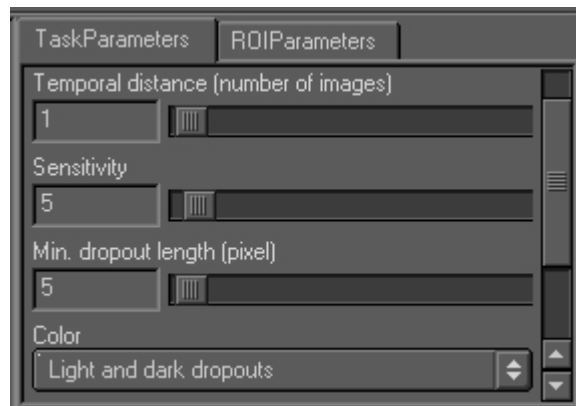
Render ROI only

If this option is selected, the tool will affect only images that have a ROI selection.

Temporal distance

0 means that only information from the current image is used for detection of dropouts, values larger than that extend the analysis basis by adjacent images.

Typical values are 0 and 1!



Sensitivity

The higher the value the more dropouts are detected. This parameter is usually a measure for the contrast difference between dropout and background. Typical values for black or white dropouts are between 2 and 5, for more decent dropouts the value needs to be augmented.

Min. dropout length

Define if the minimal length of a dropout. The lower the value the more dropouts are detected,

thus there is a danger to misinterpret interlacing effects as dropout. Use short values only in conjunction with low sensitivity!

Color

Defines the general color of a Dropout, usually the operator should have separate instances for dark and bright dropouts.

Comparison basis

For dropouts being longer than one horizontal line the “One Line” option should be selected. For shorter dropouts “Two Lines” should be selected as the replacement function is much better if image information is taken only from other parts of the same half-frame (even or odd).

4.2.19 ExportQT / ExportDVS

These tools are only available if your configuration supports an external video-monitor for real-time playback.

The Export tool need to be put as last tool in the restoration hierarchy. The tool does not do any restoration, but it prepares and publishes the restored images so that they can be used by the supporting hardware to play them back in real-time.

Playback itself is not initiated by these tools, but you can use the RealTime Playback function from the RestorationManager.

QuickTime

ExportQT should be used if you started your restoration with from a Quicktime, that has been captured by a Quicktime supporting device (e.g.: BlackMagic DeckLink HD Pro). In this case ExportQT updates the Quicktime movie (that has been used to import the data) such that it contains the restoration results.

DVS

If you use a product from the German supplier DVS with the native DVS formats “disk recorder” and OSFS then you need to use ExportDVS. The tools exports the restored images into a clip that can be displayed by the DVS device.

Settings

Please consult our system support for assistance.

In general you have the choice between exporting all images or just update those that have been rendered in the current DIAMANT generation. If you consequently use the Export tool as last tool in each DIAMANT generation, then the update option should be selected. If you don't do that, but you want to see the summary of all your restoration steps at a certain time, you should export all images.

4.3 MovieManager Tools

There is a variety of tools available directly from MovieManager. Those tools are not restoration specific, but more of general purpose.

All tools available in MovieManager are running on the local workstation only. They do not require nor make use of any attached render-farm.

4.3.1 TimeStretch

Tool for temporal adjustment of a movie sequence.

Starting from DIAMANT

TimeStretch is available in MovieManager as a tool on any imported sequence. If you select the context-menu of your sequence (click-right) you can start TimeStretch.

TimeStretch creates as result a new sequence that has a different temporal duration, depending on the settings.

Settings

Input sequence

Defines the sequence in terms of the DIAMANT hierarchy (project/movie/sequence) and the start- as well as end-point. If you start TimeStretch from the context-menu of MovieManager the pre-filled setting is the selected sequence and its first and last image as start-/end-point.



The screenshot shows a dialog box titled "Input sequence" with a dark gray background. It contains several input fields and a checkbox. The "Project" field is set to "Disk_E", the "Movie" field is set to "samples", and the "Sequence" field is set to "HongKong_SD". Each of these three fields has a small right-pointing arrow button to its right. Below these, the "Source In" field is set to "1" and the "Source Out" field is set to "4001". At the bottom left, there is a checkbox labeled "Interlaced material" which is currently unchecked.

In order to properly handle interlaced material you need to select the CheckBox.

Speed factor

Values above 1 result in an output sequence, shorter than the input sequence. Thus some images need to be dropped. Values below 1 result in a temporal prolongation of the output sequence.



Some common factors:

Input sequence	Output sequence	Speed factor
Film (24fps)	Video (PAL, 25fps)	0.96
Film (18fps)	Video (PAL, 25fps)	0.72
Film (16fps)	Video (PAL, 25fps)	0.64
Film (24fps)	Video (NTSC, 30fps)	0.80
Video (PAL, 25fps)	Video (NTSC, 30fps)	0.8333333333

Output sequence

Defines the sequence in terms of the DIAMANT hierarchy (project/movie/sequence) and the start- as well as end-point. If you start TimeStretch from the context-menu of MovieManager the pre-filled setting is the same than input, but the sequence-name with postfix “_stretched”. Start- and end-point are automatically calculated from the Speed factor.



If you change the end-point manually the Speed factor parameter is influenced!

Stretching mode

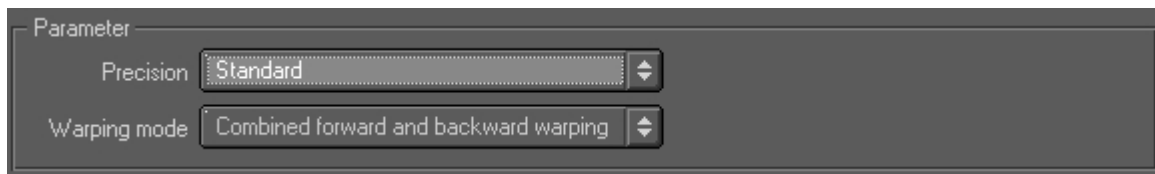
Important setting that defines how the images to be inserted are calculated. Usually you should select “Interpolate new”, which guarantees that the inserted images are interpolated between their neighbouring images. Thus any frame-repetition can be avoided.



If you select “Copy new” you get frame repetitions, whereas “Full interpolation” creates all images by resampling the full time-line. Theoretically this is the perfect approach, but practically this is a very time-consuming selection with the risk of side-effects. So be careful when using this option.

Parameter

Provides some additional parameters, depending on the selected Stretching mode. Usually the defaults should be fine.



Precision indicates to which extent a (spatial) subsampling should be used, whereas warping mode indicates if interpolation should work in both directions or not. Both parameters strongly influence calculation speed of the tool.

5 Step-by-step tutorial

Although Diamant has been developed in close cooperation with preservation institutes and non-trained IT users, restoration remains a complex task.

Thus we have released a specific document called “step-by-step tutorial”. Based on this document, we assist ongoing operators on the road to their first success.

The document is available on demand, please send a informal request to get it.

6 Settings

6.1 Lookup tables (LUT)

Lookup-Tables (LUTs) are used for 2 different purposes in DIAMANT.

As DIAMANT internally always works on either 8 or 16bit linear, any 10bit and/or logarithmic file format (e.g.: DPX, CIN) has to be converted by means of a LUT. This LUT is specified in the DIAMANT configuration and should not be changed by the operator. For the images itself the LUT's in such cases are transparent, but if you have a special scanning case, there might be need to change this internal LUT. Please consult our support-team in such a case!

6.1.1 Display LUT

Display LUT's influence the visualisation and appearance of the movie for the operator. Therefore this LUT can be easily changed. The option is offered in the Configure menu of the MovieManager and directly in some applications (e.g.: RestorationManager).

6.1.2 Configuration

Select the required LUT and configure any parameters (Reference Levels, Code offset, etc.). Click "OK" to save the settings and close the window.















6.1.3 Implementing user defined LUTs




Additional LUTs can be used in the DIAMANT system. Each LUT has to be provided as a text file. Currently DIAMANT supports a variety of proprietary LUT formats (e.g.: DVS, Discreet,...).

After stopping and restarting the DIAMANT software, the new LUT can be used.

6.2 RM (Shortcuts)

Find attached a table with the most convenient shortcuts as they are available from DIAMANT RestorationManager.

Keyboard	Mouse	Button	Value
Space		 , 	Play / stop
"←"			move back; change direction of play
"→"			move forward; change direction of play
Pos1			jump to first frame within image sequence
End			jump to last frame within image sequence
			fast forward
			rewind
"→"			step forward
"←"			step backward
Shift+"→"			jump to next Marker / Reference
Shift+"←"			jump to last Marker / Reference
Ctrl+"→"			jump to next shot
Ctrl+"←"			jump to previous shot
Alt+"→"			jump to next image containing a ROI
Alt+"←"			jump to previous image containing a ROI
		 Loop	set play mode to loop
	 PingPong		set play mode to back/forward
	 No Loop		set play mode normal
	 Shot		set play area to current shot / cut
	 No Stop		set play area to image sequence
	 Marker		set play area between neighbouring markers
Ctrl+Tab			open additional output window in original size

Tab			toggles between input and output image sequence; works only when you have an active Ctrl+Tab window
"c"			set or unset a new shot / cut
"i"			set start position for render area
"o"			set end position for render area
"k"			set start position of active task
"l"			set end position of active task
Del			delete selected ROI
			delete all ROI's of selected task
Ctrl+Del			Delete selected task
"r"			set or unset a marker / reference
Ctrl+"r"			delete all reference frames / markers from render area
Ctrl+"c"			delete all reference frames / markers from render area
Shift + Module selection			insert module as task over the whole length of the image sequence
Ctrl + Module selection			insert module as task over the whole shot.
right mouse button			If drawing a polygon, close the drawing of a polygonal ROI, the next point will open a new polygon. Otherwise switch to the 'Selector' tool.
Ctrl + draw ROI			define ROI on current shot length
Shift + draw ROI			Define ROI on task length
Alt + draw ROI			Define ROI on current frame only
Esc			Switch to the 'Selector' tool (Pointer)
'1'			Switch to 'rectangle' tool
'2'			Switch to 'ellipse' tool

'3'			Switch to 'polygon' tool
'4'			Switch to 'pointlist' tool, if module supports pointlist (point locking and point filter)
'5'			Switch to 'animated ROI' tool
Ctrl + right mouse on ROI-point			Add the point to the selected points
Alt + right mouse on ROI-point			Insert another point in the ROI (if Polygon)
Ctrl + draw rectangle			Select all ROI-points, that are in the rectangle

6.3 M.I.R. (Shortcuts)

Find attached a table with the most convenient shortcuts as they are available from Moving Image Retoucher.

Function	Keyboard, mouse, table	Button
Navigation		
play/stop	space	
move back; change direction of play	“←”	
move forward; change direction of play	”→”	
goto to first image	Pos1	
goto to last image	End	
goto inpoint	Ctrl+I	
goto outpoint	Ctrl+O	
set inpoint	I	
set outpoint	O	
goto next Marker	Ctrl+”→”	
goto previous Marker	Ctrl+“←”	
set marker	M	

Set cut	C	
Set Reference	R	
Set bookmark	B	
Delete all cuts	Ctrl+Alt+C	
Delete all reference markers	Ctrl+Alt+R	
Delete all bookmarks	Ctrl+Alt+B	
Select marker type		
Settings		
Leave MIR	Ctrl+Q	
Full Screen	Ctrl+F	
Reset all retouch parameters	Esc	
Play every image or real-time	Ctrl+E	
Visualisation		
Zoom in	Mouse-wheel	
Move target image	Ctrl+mouse	
Move source image	Alt+mouse	
Select Monocle	V	
Change scale in Monocle	Ctrl+mousewheel	
Retouch / Repair		
Fix (apply mask and safe)	F	
Clear mask	Del	
Preview brush (retouch simulation)	W	
Apply brush	Mouse (left)	
Undo brush	Mouse (right)	
Small brush	1	
Medium brush	2	
Large brush	3	
Use Default brush	Ctrl+1	
Use Vertical brush	Ctrl+2	
Use Horizontal brush	Ctrl+3	
Increment temporal offset	Alt+”→”	
Decrement temporal offset	Alt+“←”	

Reset temporal offset	S	
Change brush size	Shift+mousewheel	
Change brush size horizontal	Shift+X+mousewheel	
Change brush size vertical	Shift+Y+mousewheel	
Change temporal offset of source	Shift+T+mousewheel	
Change horizontal offset of source	Shift+X+mousewheel	
Change vertical offset of source	Shift+Y+mousewheel	